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EDUCATIONAL MANUAL No. 13

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INTERIOR WIRING

EDUCATION AND RECREATION

SPECIAL SCHOOL

CAMP GRANT, ILLINOIS

1920

INTRODUCTION

For many years the army has been developing a system of training for technicians. The Engineer School at Washington Barracks, the Coast Artillery School at Fortress Monroe, and other post schools had, before the war, practical and successful schools for this purpose. The School of the Line at Fort Leavenworth had also developed a sound method of teaching based upon the same fundamental conception known throughout the army as the applicatory method.

During the war, the army was compelled to train rapidly more than 1,250,000 men in technical lines. To do this, special schools were established by every special service and in most of the large camps. When the capacity of these schools was found inadequate to meet the demand, the National Army Training Detachments were established at civilian institutions, but under military control. To meet the needs of the situation, the previous practices of the army rapidly developed into a well defined system of intensive training which attained a large degree of success.

Because of this experience during the war, the army is now continuing its system of vocational training and is endeavoring to place it on a sound and efficient basis. The results of these efforts are contained in this series of manuals. These embody the results of the war experience and of a careful study of that experience since the signing of the armistice.

The army applicatory method is designed to train the type of soldier required in modern warfare. This requires the development of good coordination of mind and body and the ability to think quickly and independently in emergencies. Since every soldier in battle is almost certain at some time to be placed in a position requiring independent action and qualities of leadership, it is essential that the training system of the army should develop independence, initiative, resourcefulness and powers of quick and sound judgment as far as possible in every man.

There are two fundamental principles underlying the applicatory method. The first is that the best method of training men to think is to place them in real situations which challenge their abilities and make thinking necessary. The second is that progress is best measured by objective standards which reveal what the man can actually do. A new tech-

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nique has been developed to express these two principles in school practice and this is presented in these manuals.

These instruction manuals have been developed at the Education and Recreation Special School at Camp Grant, Illinois, during the past winter by a group of civilian experts, under the direction of Dean R. W. Selvidge, of the University of Missouri. The manual for Interior Wiring has been prepared by Mr. A. H. Fensholt and Mr. O. B. Fensholt. It is submitted to the service for criticism and suggestion, with the firm conviction that if the instructors in army schools will follow the general methods herein indicated, using their own jobs adapted to their local situations, the most satisfactory results will be secured both for each individual school and for the army as a whole.

Washington,
1920.

C. R. Mann,
Chairman, Advisory Board.

ELECTRICAL DEPARTMENT

INTERIOR WIRING

Requirements and possibilities of the trade

The interior wireman is a skilled mechanic, and he enjoys the benefits of a tradesman whose work is pleasant, whose services will always be needed as long as electricity is used, and whose compensation is equal to that paid to any of the well-paid building tradesmen.

The Interior wireman installs systems of electric wiring in buildings of all kinds, ranging from the smallest shed to the largest skyscraper. His work covers every form of wiring, from the installation of a single lamp socket to the complete wiring system of an office building containing electric lights, motors, elevators, signals, and automatic devices.

The working conditions are good and vary with the job. Since nearly all of the work is indoors, the wireman is not asked to suffer from continued exposure to the weather. The wireman rarely works under bad working conditions, and then only for a short time while enlarging or changing some old installation, and then his lot is no worse than those of the plumber, carpenter, steam fitter, or other tradesman usually found on the same job.

The stability of employment is similar to that of any of the building trades, with the added advantage that much of the work of the interior wireman is done in wiring finished buildings, which can be done when the regular program of new building is light or stopped entirely. There also is much industrial wiring to be done, as in factories and mills, which knows no season. Many wiremen are employed continuously by large industrial plants for making the many changes in wiring continually being made in such plants.

The demand for interior wiremen seems to be increasing annually. When it is remembered that but a small portion of the houses, both in town and in the country, are wired for electricity, it is evident that much work is ahead of the wireman before all houses and buildings in the United States have been wired for electricity. The demand shows no reduction, and none is in sight.

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The supply of skilled interior wiremen is usually not adequate to meet the demand and, in times of great activity, wiremen are often paid a premium ranging from fifty cents to two dollars per day in addition to the regular scale of wages. There seems to be little danger of an over supply of skilled wiremen at the present time.

The wages of the interior wireman varies with the community in which he works. Trade organizations have established wage scales in force in many of the large cities and surrounding territory, which, in a city like Chicago, average around \$1.25 per hour for a journeyman. This scale is modified frequently by agreement between the trade organizations and the contractors.

The apprentice receives a wage arranged by contract with his employer and applies during the first year of his apprenticeship. The second year he receives one-third of the journeyman's scale; the third year he receives one-half of the journeyman's scale; and the fourth year two-thirds of the journeyman's scale.

The possibility of private enterprise is good, especially in the smaller communities, although competent electricians with good business judgment are establishing themselves as contractors and are carrying on a volume of business dependent only upon their financial resources and business training. The added possibility of combining an appliance sales business with a regular contracting business makes for increased interest and profit.

SUGGESTIONS TO INSTRUCTORS

In the productive operations of a trade are found the best conditions for teaching a man that trade. We have, therefore, so arranged the material in these manuals that a man may readily use it to analyze his job and to plan the order of procedure in doing it. It is this ability to analyze and plan a job that forms the chief mark of distinction between the high-grade and low-grade mechanic.

The Analysis of a trade is a list of the things a man must be able to do in order to be a proficient worker in the trade. It is, therefore, a list of the things we must teach him. The items appearing in this analysis are called Unit Operations. By this term we mean the fundamental mechanical processes of the trade which occur in practically identical form in many jobs. Thus, soldering is considered a unit operation in the tinner's trade, sawing a unit operation in carpentry, and plain seaming a unit operation in canvas working.

In analyzing a trade into its unit operations certain minor operations are omitted when such operations appear too simple to require instruction as to method of performance. The number of unit operations may be increased by sub-division of any one of the operations now assumed to be a unit. The instructor should make further sub-divisions if in his experience it appears to be desirable. In this he should be guided by what the mechanic ordinarily regards as a unit in his work. A job is a specific task involving one or more of these unit operations.

The Operation Sheets give specific and concise directions for the performing of the unit operations. References are given at the beginning of the Operation Sheet. It is expected that copies of all reference material referred to in the Operation Sheets will be available at all times in the shop or classroom.

The directions on the Operation Sheets are followed by a series of questions. These questions are designed to direct the attention of the student to important points covered in the references and to direct his thinking to the reasons for performing the operations in the way indicated. They also serve as a concise review of the principles involved in the right performance of the unit operation. It will be noted that no questions are directly answered in the directions. Instructors may find it necessary to supplement this list of questions.

The Information Sheets deal with the general principles lying back of the work of the trade rather than with manipulative processes. They treat more particularly of the science, mathematics and drawing commonly classed under the head of collateral information. This information is set down defi-

nitely, briefly and without discussion. It is followed by a series of questions calculated to arouse the interest of the student and to serve as a guide in reading available reference material. It is intended that the work of the shop shall be supplemented by free discussion with the class during the problem hour.

Vocational Problems are problems in science, mathematics and drawing which arise frequently in the trade. These problems the proficient worker must be able to solve. In the short time needed to learn the manipulative processes of a trade he will hardly meet with enough of these problems to find sufficient practice to enable him to solve them with promptness and accuracy. It is the purpose of the Information Sheets and Vocational Problems to give him the practice necessary for him to proceed with confidence to the solution of the problems of his trade. This practice should be given on problems directly related to the trade in which he is engaged.

Since the Analysis Sheet constitutes a list of the things a man must be able to do in order to be proficient in his trade, it will be seen that the time element is not to be considered. The only element to be considered is his ability to perform these operations. For example, one man may learn all the operations of his trade in six months where another may require a year to reach the same standard of proficiency. The whole fabric of Trade Analysis, Operation Sheets, and Information Sheets is designed to afford the greatest flexibility in the accommodation of the work to the requirements of different individuals.

In teaching the manipulative processes of a trade, classes should not exceed twenty men; twelve to fifteen is a more desirable number. In order to handle classes in trade work with the greatest degree of ease and success, instructors will find it desirable to divide the class into small groups of not more than four or five men. A leader should be appointed for each of these groups and the instructor should deal chiefly with these leaders. In choosing the group leaders the instructor should have in mind not only their knowledge of the particular kind of work in hand, but their personality and ability to lead their groups. General directions should be given to the group leaders and they should be held responsible for the conduct of the men and the care of tools and materials used by their groups. By meeting these group leaders a few minutes each day the instructor can soon develop in them a sense of responsibility and power of leadership. Such a plan will simplify the whole problem of instruction.

It is important that the instructor have a complete list of the jobs to be done about the camp or post that will be avail-

able for his class. The instructor should analyze each of these jobs carefully and list each of the operations involved. To this list of operations should be attached a list of materials and tools required to do the job. The list of jobs should be kept on file so that they may be assigned to men at any time.

The men in school should never be called upon to do a job that has not first been approved by the instructor. A teacher should never approve a job which does not contain the elements in the performance of which he desires to instruct. Nothing can so demoralize a class as to have someone who is unfamiliar with the instructor's plan direct him to take his class and perform a piece of work which he has had no opportunity to plan and which does not fit into his scheme of instruction.

The instructor should talk things over with the members of his class to give them a thorough understanding of the general plan of the work before they start on their job.

Beginners should be given jobs which involve only a few simple operations. Along with the assignment of a job a man should be given a trade analysis sheet and be asked to look over the job and check on the trade analysis sheet the unit operations involved in its execution. After this list is checked the instructor should examine it and compare it with his own scheme for doing the job. If the list of unit operations checked contains operations which should not have been checked, or if operations have been omitted which should have been checked, the man should be asked to consider the job carefully again and to discover, if possible, his error. Perhaps ignorance of certain requirements of the trade may result in the omission of some of the unit operations and a casual question or two from the instructor should lead the man to succeed in his analysis. It may be necessary also to explain to the new man the meaning of the terms used in the analysis.

Having analyzed the job for the unit operations involved the next duty of the man is to plan the procedure for doing it. To do this, he should list the operations in the order in which they occur in the execution of the job. In some instances it will be found that a number of operations will occur simultaneously. In that case it should be so indicated. It is often true that different orders of procedure are equally good. The instructor should, therefore, question the man concerning his reasons for proceeding in the way he has indicated and, if he gives good reasons, he should be permitted to follow his own plan even though it is not the usual order.

The importance of such an analysis and plan can scarcely be overestimated. The learning of manipulative processes, while important, constitutes but one part of the learning of the

trade. The man who does not learn to analyze his job and to think constructively and quickly concerning it will always be handicapped in his work.

When the man has completed his analysis and plan of the job he should be given the operation sheets which tell him how to perform the operations involved. These operation sheets should be read carefully by him before he begins his work, and should be at hand for reference, if needed, at any time during the progress of the job.

When men are sent out from the shop to do a piece of work they should be in charge of the instructor or of the most competent man available in the group and should take along with them the instruction manuals and the necessary tools and materials, if such can be determined before going to the job.

The instructor should set aside a period for discussion of the topics of information and the problems connected with the trade. This hour should be used to take up the questions the men may raise concerning the operations or the general principles underlying their work. The instructor should never hesitate to teach a man anything he needs to know, whether it is on the schedule or not.

It will be found that it is necessary for men to perform certain operations a great many times in order to become proficient in them. When they have become proficient in any operation of the trade they should be given a proficiency mark and, while these operations may subsequently occur many times in their work, the instructor should seek to give them jobs in which new operations occur. Men should not be regarded as proficient in any operation until they can perform it as well as the average workman in that trade.

This manual is not intended as a substitute for the instructor, but as a help to him. The operation sheets are simply carefully worked-out plans for teaching the various operations of the trade and, when the operation sheets for any job are assembled, they constitute a plan for teaching the operations involved in that job, thus relieving the teacher of a vast amount of labor.

It is earnestly requested that every instructor who uses these manuals study them carefully with a view of improving them. Send all suggestions for improvement to Education and Recreation Branch, War Plans Division, War Department, Washington, D. C.

R. W. Selvidge,
Supervisor of Instruction,
Education and Recreation Special School,
Camp Grant, 1920.

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Job _____

Date _____

Name _____

Instructions:

First: Check at the left each unit operation involved in the job.

Second: Place in the column at the right the numbers checked in the order in which the unit operations should be performed.

UNIT OPERATION	Order of Procedure
General	
1. Planning and estimating the job.	
2. Making a bill of material.	
Rigid iron conduit	
3. Cutting.	
4. Threading and reaming.	
5. Making a running-thread joint.	
6. Bending.	
7. Throwing an offset.	
8. Installing.	
9. Connecting to boxes and fittings.	
Flexible steel conduit (Greenfield)	
10. Cutting and reaming.	
11. Coupling.	
12. Installing.	
13. Connecting to boxes and fittings.	
Flexible armored conduit (BX)	
14. Cutting.	
15. Stripping armor for splices.	
16. Installing.	
17. Connecting to boxes and fittings.	

UNIT OPERATION	Order of Procedure
Metal molding	
18. Cutting.	
19. Slotting.	
20. Coupling.	
21. Bending.	
22. Mitering an edgewise turn.	
23. Mitering a flatwise turn.	
24. Installing.	
25. Connecting to boxes and fittings.	
Ovalduct	
26. Cutting and reaming.	
27. Bending.	
28. Coupling.	
29. Installing.	
30. Connecting to boxes and fittings.	
Wooden molding	
31. Cutting.	
32. Bending.	
33. Mitering.	
34. Installing.	
Knob, tube, and cleat wiring	
35. Installing running boards and guard strips.	
36. Installing knobs.	
37. Installing cleats.	
38. Installing tubes.	
39. Making a turn.	
40. Making a "dead end."	
41. Tapping a circuit.	
42. Installing loom.	
43. Stringing conductors.	
44. Connecting to boxes and fittings.	
Boxes and fittings	
45. Installing switch box in unfinished frame wall.	
46. Installing switch box in unfinished fire-proof wall.	
47. Installing switch box in wood lath and plaster.	

UNIT OPERATION	Order of Procedure
<p>48. Installing switch box in wire lath and plaster.</p> <p>49. Installing switch box in tile and plaster.</p> <p>50. Installing switch box in baseboard.</p> <p>51. Installing switch box for metal molding.</p> <p>52. Installing exposed outlet box.</p> <p>53. Installing fixture outlet box at gas outlet.</p> <p>54. Installing fixture outlet box in unfinished frame building.</p> <p>55. Installing fixture outlet box in unfinished fireproof building.</p> <p>56. Installing fixture outlet box in wood lath and plaster.</p> <p>57. Installing fixture outlet box in wire lath or wallboard.</p> <p>58. Installing fixture outlet box in tile and plaster.</p> <p>59. Installing fixture outlet box for metal molding.</p> <p>60. Installing cut-out and panel boxes.</p> <p>61. Installing special conduit fittings.</p>	
Fixtures	
<p>62. Making an Underwriters' knot.</p> <p>63. Installing drop cord.</p> <p>64. Installing fixture with crow-foot.</p> <p>65. Installing fixture on gas outlet in outlet box.</p> <p>66. Installing fixture on stud in outlet box.</p> <p>67. Installing a chain fixture.</p>	
Switches and receptacles	
<p>68. Installing flush switch or receptacle.</p> <p>69. Installing snap switch or spider cover.</p> <p>70. Installing snap switch for knob and cleat wiring.</p> <p>71. Installing switch or receptacle on wooden molding.</p>	

UNIT OPERATION	Order of Procedure
Splicing and soldering 72. Making a rat-tail splice. 73. Making a fixture joint. 74. Making a Western Union joint. 75. Making a Tee-joint. 76. Splicing stranded conductors. 77. Starting a blow-torch. 78. Tinning a soldering iron. 79. Soldering joints. 80. Soldering lugs. 81. Tapping joints.	
Fishing and exploring 82. Removing floor boards. 83. Replacing floor boards. 84. Removing and replacing trim. 85. Cutting wall paper. 86. Running fish-wire into conduit. 87. Pulling conductors into conduit. 88. Fishing flexible conduit. 89. Fishing flexible armored conductor. 90. Fishing loom-covered conductor. 91. Fishing with a "mouse." 92. Fishing with a "hooked snake." 93. Fishing with a "mouse" and "looped snake." 94. Exploring with a mirror and lamp. 95. Exploring with a "mouse" or a fish-tape. 96. Exploring with a "feeler" bit. 97. Drilling through brick walls. 98. Drilling through plates and bridges. 99. Carrying conductors around a bridge.	
Miscellaneous operations 100. Tracing and testing circuits. 101. Grounding conduit or molding. 102. Installing bell and signal wiring.	

ELECTRICAL DEPARTMENT INTERIOR WIRING

Planning and estimating the job

References:

- Nelson, "Interior Electric Wiring and Estimating," p. 223.
Croft, "Wiring of Finished Buildings," p. 54.

Directions:

1. Examine the installation or building in which the job will be done and make a sketch, approximately to scale, showing the location of walls, windows, doors, stairs and other details which have a bearing upon the job. Omit details which have no connection with the installation.

2. Indicate on the sketch the location of each outlet and the type of each outlet, indicating whether the outlet is for a switch, fixture, socket, current tap, etc. Also determine style and finish of fixtures.

3. Indicate the point at which the main line will be tapped for the new circuit or, if no main line is in existence, show the point of entrance of the main line.

4. Indicate the location of the service entrance box or of panel boxes, if such are necessary.

5. Indicate the approximate distances between outlets, or from outlet to main line, or any other distances which are necessary for computing the length of runs.

6. Indicate the kind and size of conduit, molding, flexible armored conductor or tubing to be used for each run.

7. Indicate the size, number, and kinds of conductors to be used in each run.

8. Make a bill of material from the sketch, indicating in detail the quantity and type of material wanted for the job, including such supplies as solder, flux, nails, etc.

Questions:

1. *What symbol should be used in indicating the various types of outlets?*
2. *Is it necessary for the estimator to have a knowledge of building construction?*
3. *In competitive estimating is it advisable to learn what type of installation is contemplated by other bidders?*

ELECTRICAL DEPARTMENT

INTERIOR WIRING

Making a bill of material

Draw up a bill of material from the plan or sketch furnished by the architect or estimator. List all supplies and materials in an itemized list, somewhat as indicated below, showing the quantities and kinds of materials wanted under each item.

When ordering the materials from manufacturers, jobbers, or dealers, the catalogue number of each item must be included with the quantity of the item. When ordering the materials from the warehouse of the contractor supervising the job, use the designations adopted by that contractor for the various types of materials. Never be afraid of giving too much information about the items wanted. The cause of most confusion on jobs, due to the delivery of incorrect materials is the lack of sufficient information on the bill of materials wanted, making it necessary for the warehouse clerks to guess at the items which are not clear.

The following list covers most of the items which occur on the average run of material bills. No detail is given, since the detail involved in any one item is often considerable, as, for instance, in the case fixtures.

Conduit, rigid	Bolts, stove
Conduit, flexible (Greenfield)	Bolts, machine
Conductor, flexible armored	Cabinets
(BX)	Switches, knife
Molding	Fuse blocks
Ovalduct	Fuses
Junction boxes	Fixture studs
Covers	Outlet or gas clamps
Conduit fittings	Ground clamps
Locknuts	Nipples
Bushings	Switch boxes
Box connectors	Switches, wall
Elbows, conduit	Switch plates
Elbows, molding	Receptacles
Couplings	Sockets
Pipe straps	Rubber bushings
Conduit clips	Canopies
Bolts, expansion	Shade holders

Lamp guards
Ball adjusters
Cord
Wire
Loom
Wall brackets
Insulators
Cleats
Knobs
Tubes
Insulating joints
Hickies, fixture
Knock-out blanks
Tape
Solder
Candles
Screws
Nails
Brads
Soldering flux
Federal bushings

Paint
Paint brushes
Lard oil
Motor oil
Saw blades
Lugs
Sand
Cement
Soapstone
Gasoline
Lumber
Asbestos board
Fixtures and shades
Strap iron
Fish cord
Meter fittings
Troughs
Ladders
Tools
Drop cloths

ELECTRICAL DEPARTMENT INTERIOR WIRING

Cutting rigid conduit

References:

Croft, "American Electrician's Handbook," p. 500.

Sharp, "Practical Electric Wiring," p. 110.

Directions:

1. With a file, saw-blade, or knife, mark the point of cutting conduit, allowing for fittings, bends, or thread. Place conduit in suitable pipe vise, the jaws of which should be in good condition. An ordinary bench vise is not suitable, since the flat jaws tend to flatten the conduit.

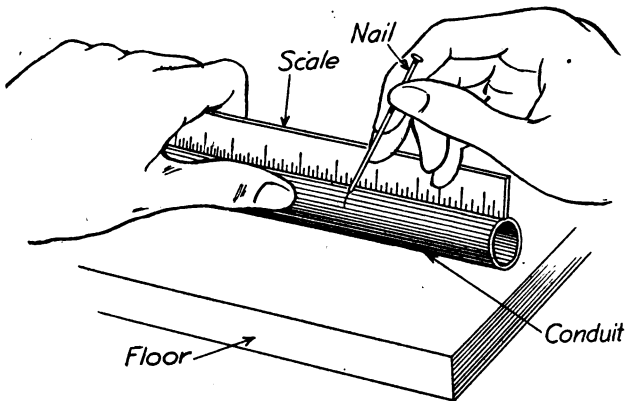


Fig. 1

2. Clamp the conduit firmly in the vise, taking care not to damage its surface unnecessarily, either by denting, by excessive pressure or by turning in the jaws of the vise.

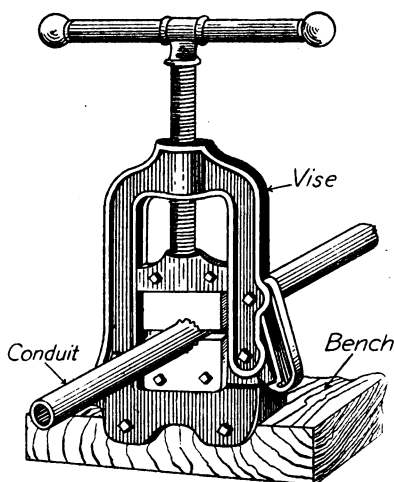


Fig. 2

3. Inspect the hack-saw blade to see whether the teeth are badly broken or if the blade is loose in the frame. For cutting iron conduit use a blade with about 14 teeth per inch. Saws with fine teeth are used for brass or very thin tubing.

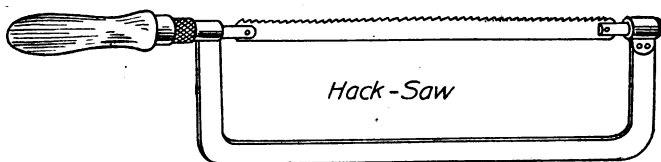
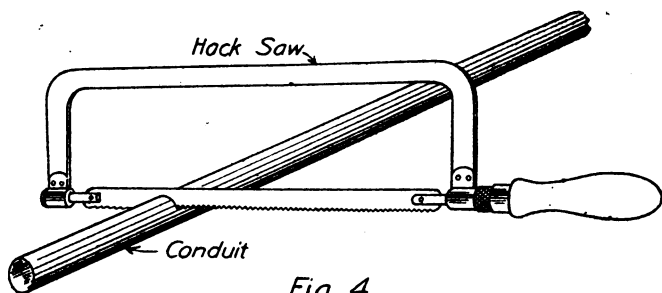


Fig. 3

4. Saw squarely through the mark with the hack-saw, being careful not to rock or bend the saw during the cutting, since the saws are very brittle and break easily.

When cutting long lengths of conduit support the free end during cutting to avoid breaking of conduit at cut and making a ragged cut which requires much reaming.



Questions:

1. *What is the correct method of placing a saw in the frame? In what direction should the teeth point?*
2. *What is the advantage of a coarse saw?*
3. *Why is the hack-saw method of cutting rigid conduit better than the pipe-cutter method used by steam-fitters for cutting steam or water pipe?*
4. *How is a short nipple held in the vise, if the vise interferes with the hack-saw frame during the cutting?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Threading and reaming rigid conduit

References:

Croft, "American Electrician's Handbook," pp. 497-499.

Directions:

1. Inspect the die for size, thread, and position in the stock. Also inspect the bushing for size. Secure the face-plate firmly before beginning work, since a loose face-plate may permit the die to leave the stock during cutting, and injure the workman.

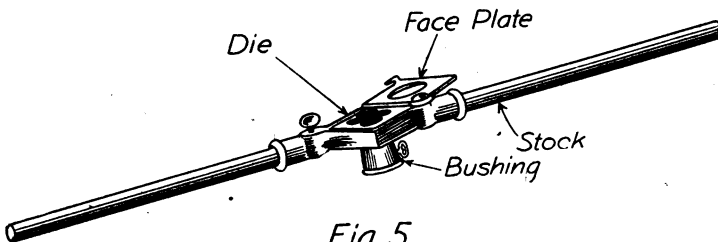


Fig. 5

2. Pour a little oil on conduit and run the stock over it until die touches it. Grip stock with both hands near the die, turn stock slowly to the right, pushing hard against conduit until die begins to cut a thread.

If stock has leader screw instead of a bushing, clamp leader screw to conduit before beginning work, and proceed as above.

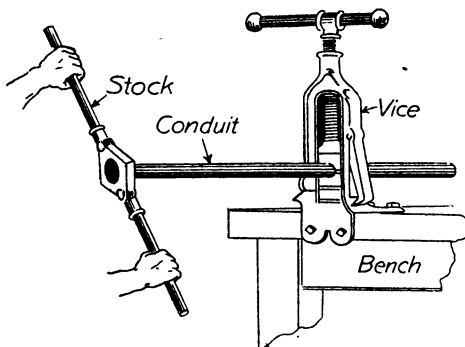


Fig. 6

3. Oil the die freely, finish cutting the thread, and rock the die backwards and forwards every two or three turns to break the chips. If the die shows any tendency to jam with chips, they should be removed.

Remove die, strike conduit with stock to knock off loose chips and inspect the thread.

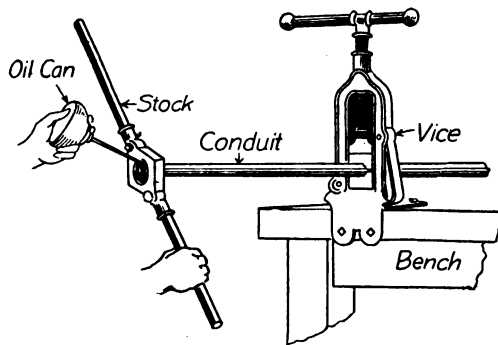


Fig. 7

4. Ream inside of conduit with burring reamer until all burrs are removed.

Several types of reamers may be used, but the burring type is most convenient since it is easily carried in the tool bag.

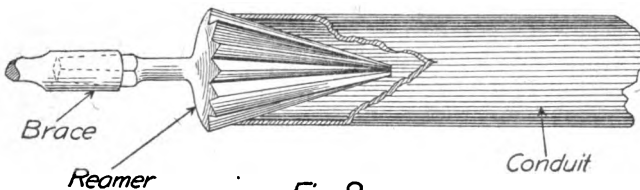


Fig. 8

Questions:

1. How are right-hand and left-hand dies marked?
2. What is meant by placing the die "in right" in the stock?
3. How do pipe threads differ from bolt threads?
4. How far should a thread be cut on the conduit?
5. What kind of oil is used in thread-cutting?
6. What may happen to the die, if no oil is used? To the thread?
7. Why is it best to run a die over old threads?
8. How can a pipe burr be removed without a standard reamer?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Making running-thread joint for rigid iron conduit

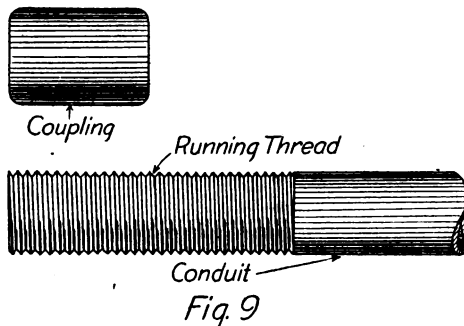
References:

Croft, "Wiring of Finished Buildings," p. 108.

Croft, "American Electrician's Handbook," p. 498.

Directions:

1. With a standard, right-hand, pipe die, thread both pieces of conduit to be connected. The thread on one piece should be of standard length, and on the other it should be cut back a distance equal to about one and one-half the length of a standard coupling.



2. Run a standard lock-nut upon the conduit with the longer thread, and follow it with a standard coupling. The coupling should be run back until the end of the conduit extends through it.



Fig. 10

3. Bring both runs of conduit together allowing the threaded ends to butt against each other. Unscrew the coupling from the long thread, screwing it at the same time upon the short thread. If done carefully, the coupling will run from one thread to the other without separating the two conduit runs very much. The coupling should be screwed upon the short thread until it is tight on that thread.

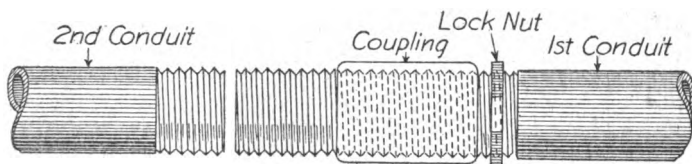


Fig. 11

4. After the coupling is in place the lock-nut is unscrewed from the long thread until it strikes the coupling. It is then secured by screwing it firmly against the coupling with a pair of gas pliers. The use of the lock-nut is extremely necessary to keep the conduit with the long thread from turning in the coupling.

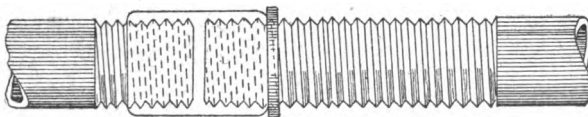


Fig. 12

Questions:

1. When are running-thread joints used?
2. What is an Erickson coupling?
3. Why is the above type of running-thread joint used by wiremen instead of couplings with right-hand and left-hand threads?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Bending rigid conduit

References:

Croft, "American Electrician's Handbook," pp. 494-497.

Cook, "Interior Wiring," p. 211.

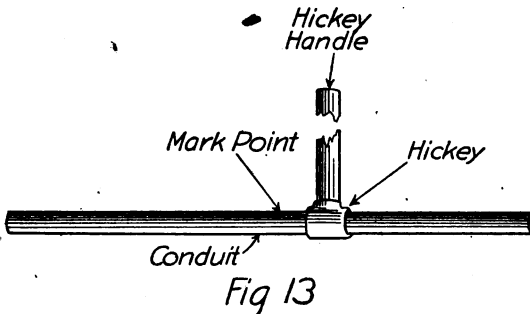
■ Sengstock, "Electrician's Wiring Manual," p. 36.

Sharp, "Practical Electric Wiring," p. 111.

Directions:

1. Determine the approximate point on the conduit at which the bend should be made, and slip the "hickey" over the conduit within a couple of inches of that point.

Sometimes a line is drawn on the floor at right angles to conduit showing the exact location of bend to assist the wireman in bending the conduit to correct amount.



2. Step on the conduit to prevent it from slipping backwards or butt one end of it against a post or wall, and bend it upwards about one-third of a complete bend.

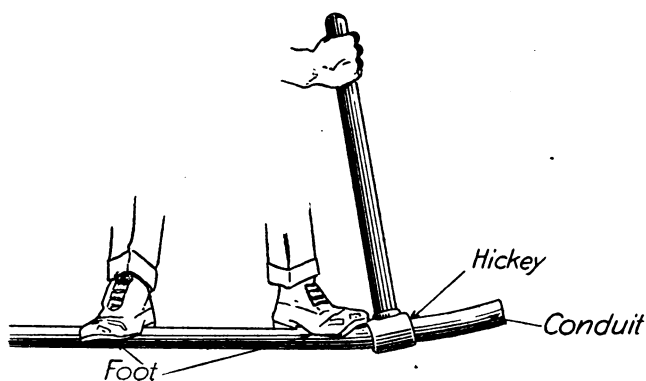


Fig. 14

3. Move the hickey on the conduit about an inch or two, depending upon the bend. A sharp kink will occur in the conduit, if the bend is made with one setting of the hickey.

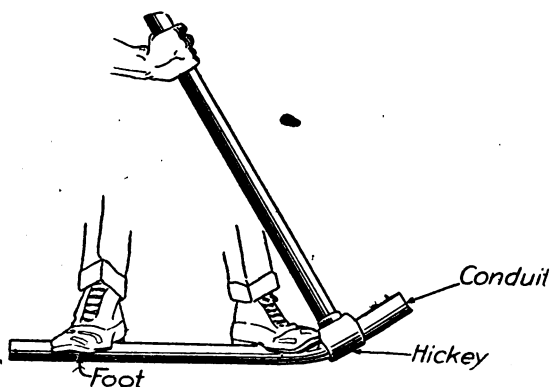
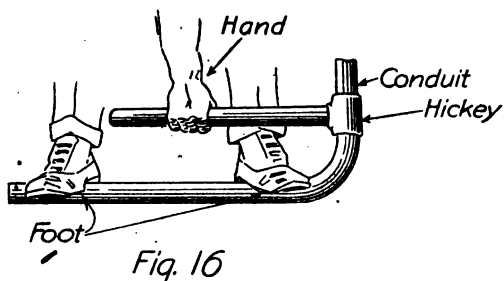


Fig. 15

4. Continue the bending process as before, moving the hickey backwards again, if necessary. Make the bend as large as possible, never less than $3\frac{1}{2}$ -inch radius.

Conduit, larger than $\frac{3}{4}$ -inch, is usually bent with some form of conduit bender, of which there are many forms. Use bender available on the job or make one as suggested in the reference given above.



Questions:

1. *Why should bends be made as large as possible?*
2. *When is it more desirable to bend conduit than to use conduit elbows?*
3. *What is meant by "throwing an offset"?*
4. *How can a conduit system turn a corner without using elbows or bends?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Throwing an offset in rigid conduit

References:

Nelson, "Interior Electric Wiring and Estimating," p. 36.

Directions:

1. With a file, knife or hack-saw mark the point on conduit at which offset shall be made.

Make first bend in offset with a hickey or pipe-bender as with any ordinary bend.

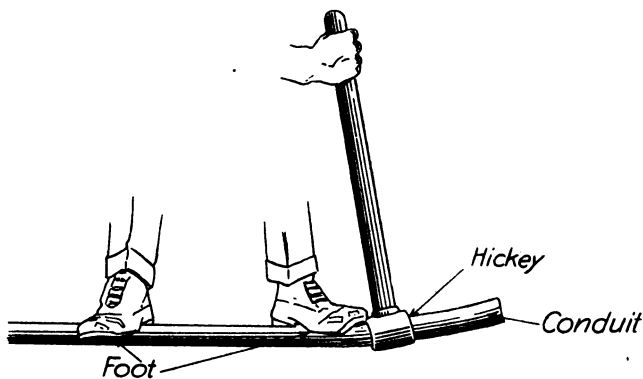


Fig. 17

2. Slip the hickey beyond the bend just made to a point near that at which the next bend is to be made.

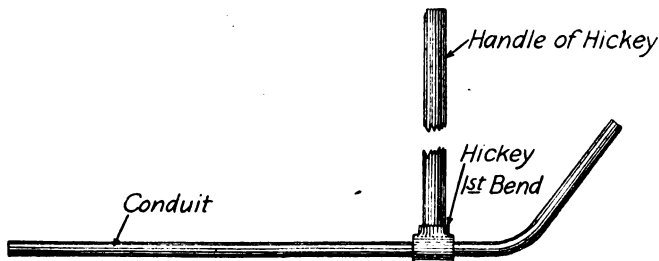


Fig. 18

3. Place the end of the handle of the hickey on the floor. With one foot hold the hickey from slipping, grasp the straight end of the conduit with both hands and bend backward enough to make the required offset. Care must be taken that the pipe does not turn in the hickey, otherwise a twist will occur in the offset.

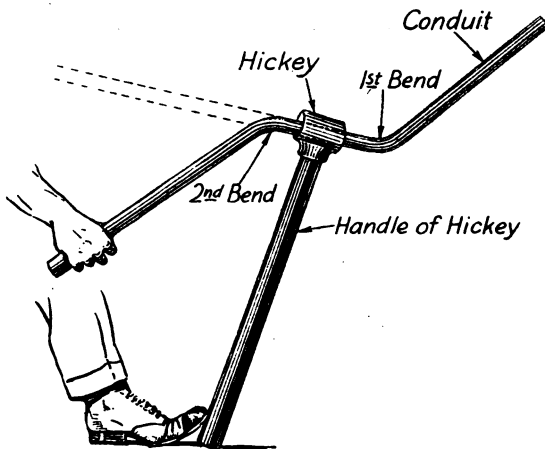


Fig.19

4. Lay conduit on floor and examine offset to see that the ends of the offset are parallel with each other. If not, straighten or bend with the hickey as the case may require.

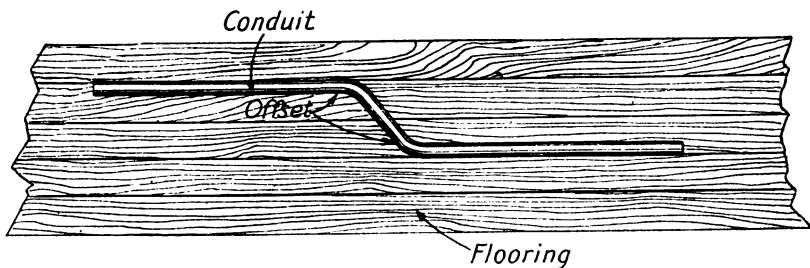


Fig.20

Questions:

1. What is the difference between a saddle bend and an offset?
2. When would an offset be used in preference to standard elbows?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing rigid conduit

References:

Nelson, "Interior Electric Wiring and Estimating," p. 34.

Sharp, "Practical Electric Wiring," p. 107.

Croft, "American Electrician's Handbook," p. 477.

Cook, "Interior Wiring," p. 209.

Directions:

1. After determining positions of outlet or other boxes to be connected remove obstructions, to permit runs with as few elbows or offsets as possible. The method of handling obstructions varies with each job and no definite instructions can be given for doing such work.

Sight through each length of conduit before bending or installing to see that it is not clogged or damaged.

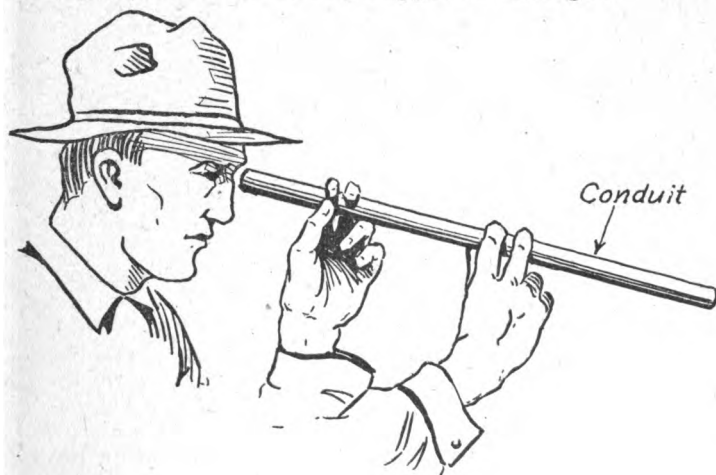


Fig.21

2. Install conduit, beginning at one outlet box and connecting each successive length with standard couplings, screwed

up tight. In some cases, due to bends in a length of conduit, it is not possible to turn the conduit, and running-thread joints, or some approved couplings must be used. Ordinary pipe unions are not permitted.

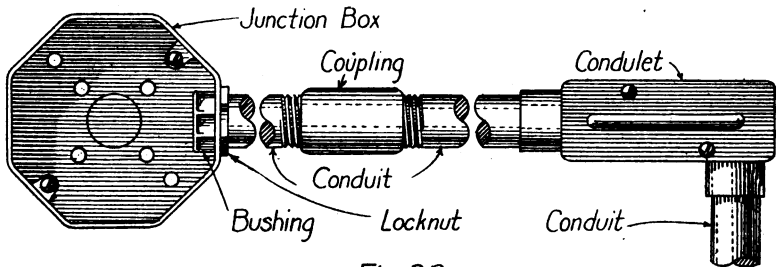


Fig. 22

3. After conduit is installed use pipe straps or other types of pipe hangers to fasten it to the surface over which it is to run.

No run must contain more than the equivalent of four quarter bends from outlet to outlet, not counting the bends at the outlet.

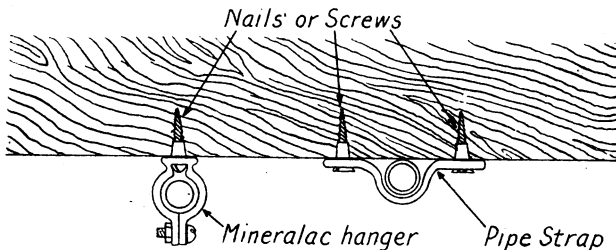


Fig. 23

4. Take every precaution during the construction period to keep dirt or other material from entering the conduit.

After the job is installed, if the conductors are not immediately pulled into the conduit, the conduit openings in the boxes or the sub ends of conduit must be plugged with cork or wood stoppers.

All conduit must be grounded.

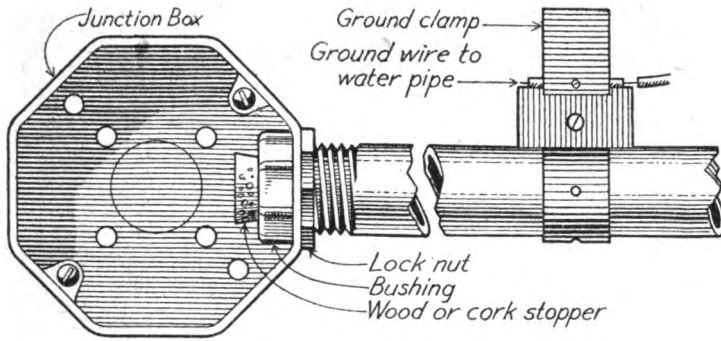


Fig. 24

Questions:

1. *Why is ordinary iron pipe not used for conduit work?*
2. *Is it permissible to bury iron conduit in the earth for underground work?*
3. *When is it advisable to use galvanized conduit?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

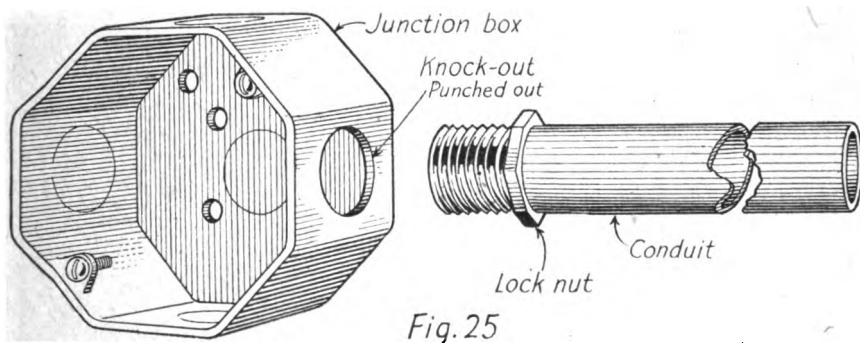
Connecting rigid conduit to boxes and fittings

References:

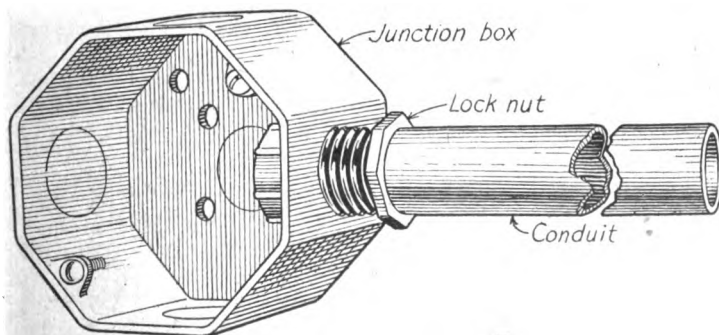
- Croft, "American Electrician's Handbook," p. 492.
- Sengstock, "Electrician's Wiring Manual," p. 12.
- Cook, "Interior Wiring," p. 214.

Directions:

1. Run a standard lock-nut over conduit to be installed in the box. Knock out with hammer or drill hole of suitable size in box to fit the conduit. The enamel and burrs around the box hole should be removed to insure good electrical contact between the box and the conduit when locked up, in order that a thoroughly grounded conduit system may result.



2. After the box has been securely nailed or screwed to wall or support, insert conduit into box with lock-nut on outside of box.



3. Run a standard conduit bushing over end of conduit, inside of box, and fasten it securely with a pair of pliers.

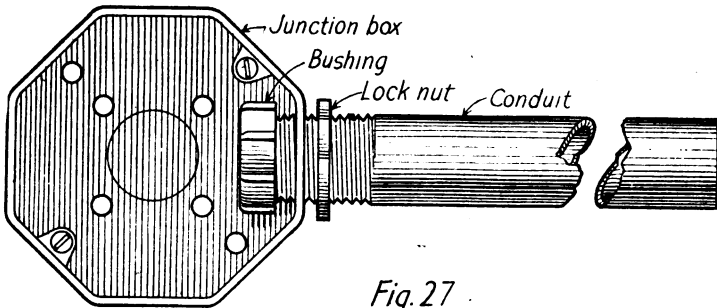


Fig. 27

4. Pull conduit back until bushing touches inside of box. Then run the lock-nut back until it touches the outside of the box and fasten it securely against the box with a pair of gas pliers.

Examine the installation for looseness between the conduit and the box.

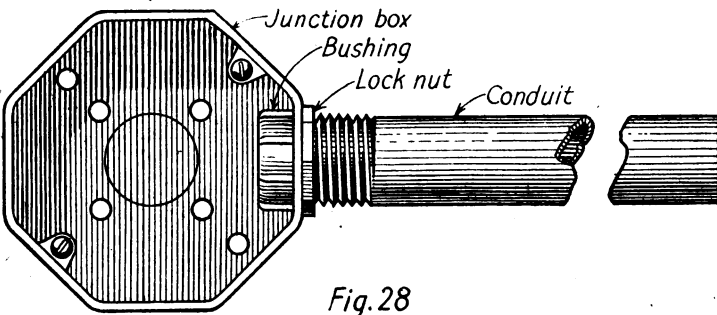


Fig. 28

Questions:

1. Why is bushing used inside of box instead of another lock-nut?
2. How can connection between box and conduit be made secure, if conduit extends into box too far to permit bushing to touch inside of box?
3. Why is it necessary to make good connections between boxes and conduit?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Cutting and reaming flexible conduit

References:

Nelson, "Interior Electric Wiring and Estimating," p. 52.

Croft, "American Electrician's Handbook," p. 512.

Directions:

1. Clamp the flexible conduit in a flat-jawed vise or hold the conduit on a board with the foot, with the point to be cut at the edge of the board. A special cutting vise or conduit cutter can be used, if available.

When clamping the conduit in a vise, be careful about squeezing the conduit out of shape.

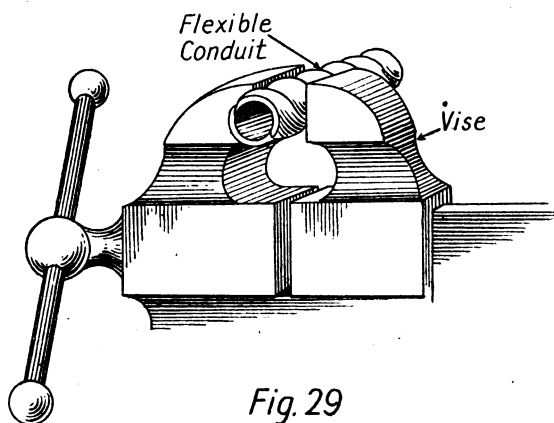
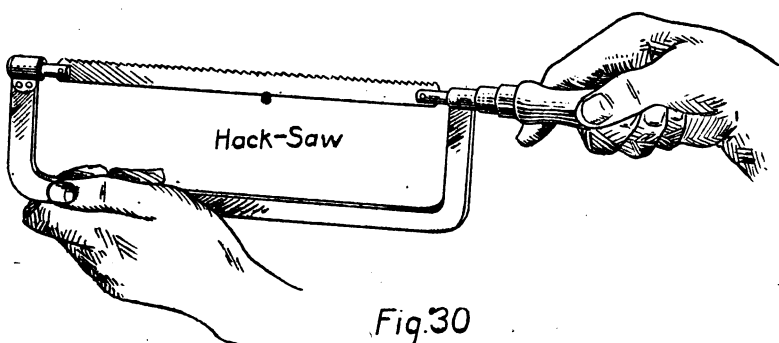


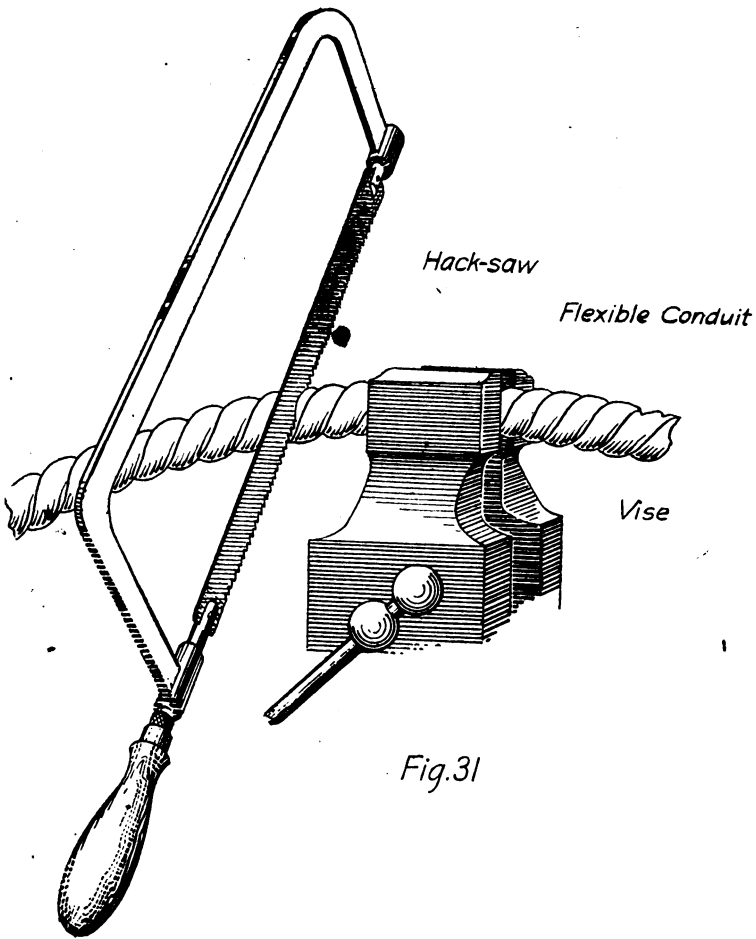
Fig. 29

2. Inspect the hack-saw to see whether the teeth are badly broken or the blade loose in the frame. A somewhat flexible saw with fine teeth is best for cutting flexible conduit, since it does not catch or break readily.



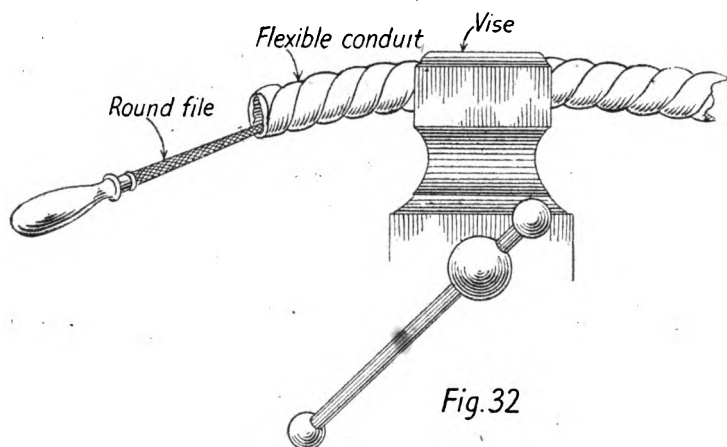
3. Begin sawing in the middle of one of the spirals, cutting squarely across the conduit. Some special vises have slots to guide the saw during the cutting.

Great care must be taken to saw squarely through the conduit so that it will fit in the connectors and couplings.



4. After the conduit has been sawed through the slight burr left by the saw must be removed with a three-cornered scraper or a file.

The end of the conduit must be inspected to see whether a point of the spiral is bent inside. If such a point is found, it must be bent back and reamed carefully.



Questions :

1. *What is the effect of using a coarse saw on flexible conduit?*
2. *Can a standard pipe reamer be used for reaming flexible conduit?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Coupling flexible conduit

References:

Croft, "American Electrician's Handbook," p. 511.

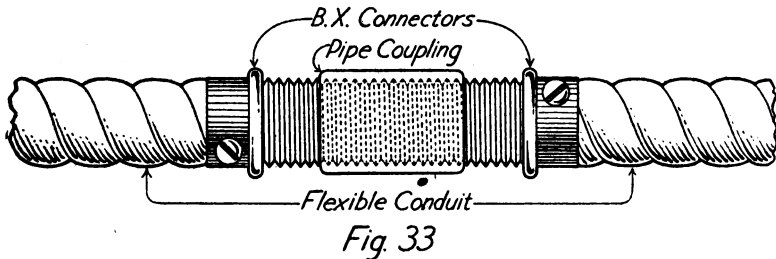
Nelson, "Interior Electric and Estimating," p. 52.

Cook, "Interior Wiring," p. 225.

Directions:

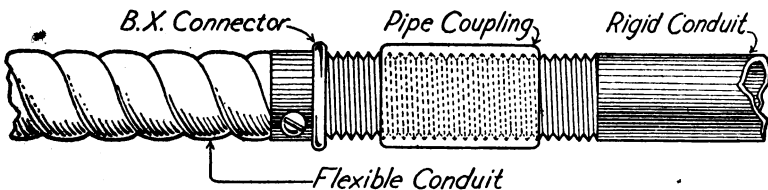
1. Coupling flexible conduit to flexible conduit with standard fittings.

Screw standard BX box connectors into each end of a standard conduit or pipe coupling. Push flexible conduit into connectors and fasten securely by regular methods used in attaching connectors to flexible conduit.



2. Coupling flexible conduit to rigid conduit with standard fittings.

Screw a standard BX box connector into one end of a standard conduit or pipe coupling. Screw coupling over end of rigid conduit and attach flexible conduit by pushing it into BX connector on coupling and securing it by regular methods used in attaching connectors to flexible conduit.



3. Coupling flexible conduit to flexible conduit with approved couplings.

Separate coupling by removing screws. Lay both ends of flexible conduit to be joined within couplings so ends touch. Replace cap of coupling, and fasten securely. Test for looseness.

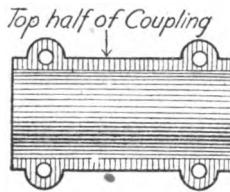
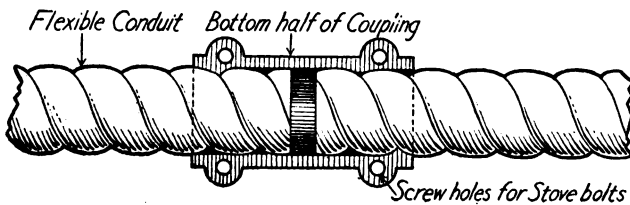


Fig. 35

4. Coupling flexible conduit to rigid conduit with approved couplings.

Separate couplings by removing screws. Lay both ends of conduits to be joined within the coupling, placing the flexible conduit on the side fitted with grooves to receive it. Replace cap and fasten securely. Test for looseness.

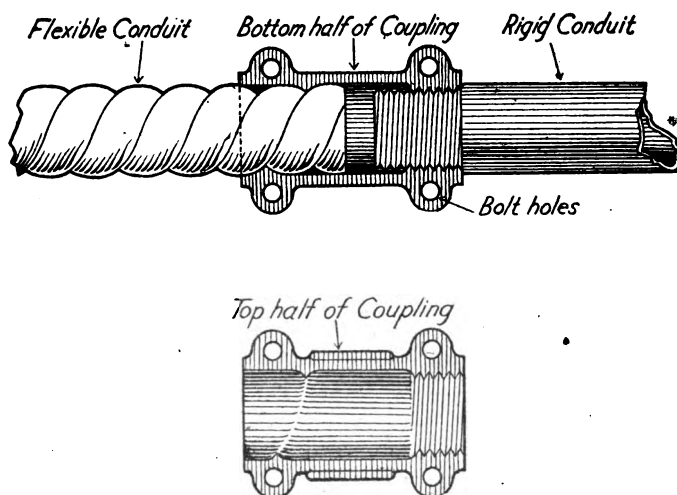


Fig. 36

Questions:

1. By what other method could two lengths of flexible conduit be joined?
2. Is it permissible to make an electrical joint within a coupling?
3. Under what conditions would flexible conduit be joined to rigid conduit?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing flexible conduit

References:

Nelson, "Interior Electric Wiring and Estimating," p. 51.

Croft, "American Electrician's Handbook," p. 511.

Cook, "Interior Wiring," p. 223.

Directions:

1. From blue print determine positions of outlet boxes and make provisions for fishing or placing flexible conduit in position between walls or over exposed surfaces.

Make all runs continuous from outlet to outlet. Approved couplings, connecting several lengths of flexible conduit, or connecting flexible conduit to rigid conduit, are considered satisfactory in continuous runs between outlets.

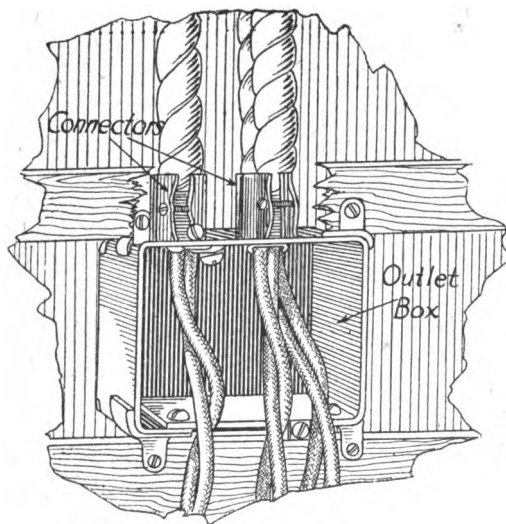


Fig.37

2. Fasten securely with pipe straps all flexible conduit when run exposed. When fished parallel to floor joists no support is necessary. When run across joists, run flexible conduit through holes bored in joists to avoid danger of penetrating armor with nails when floor is replaced.

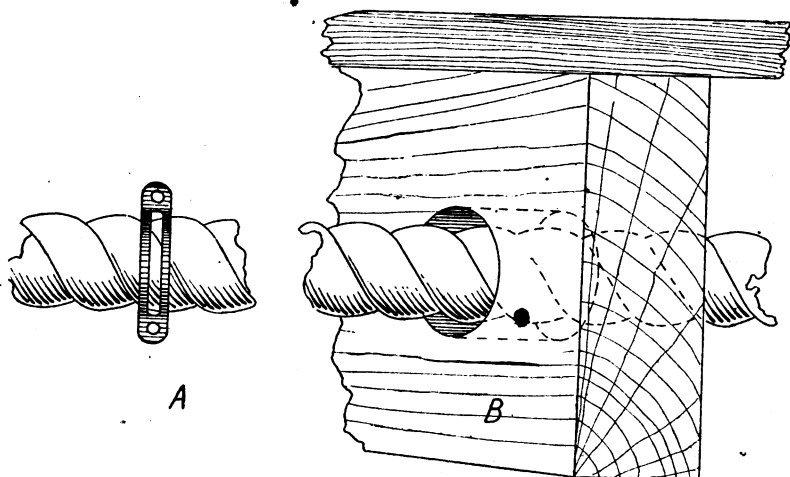


Fig. 38

3. Make all bends as large as possible and secure the conduit at bends in at least two places around the bend. Install conduit so that conductors can be pushed or fished through after all conduit is in place. If this is not possible, use flexible armored conductor. If necessary, use elbow clamps at bends that are exposed.

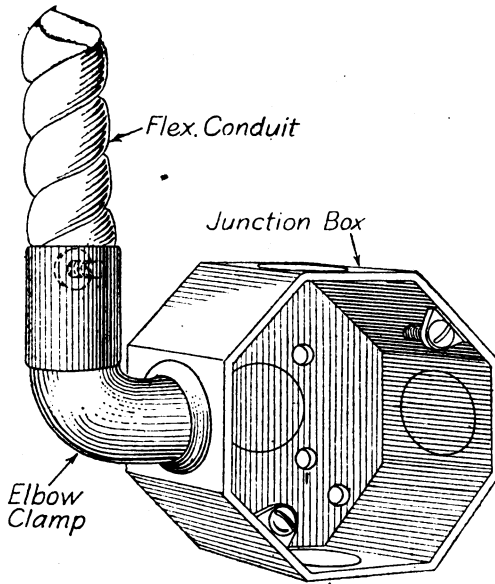


Fig.39

4. Make all connections in standard boxes and with standard fittings. Ground the conduit thoroughly. Inspect installation for looseness.

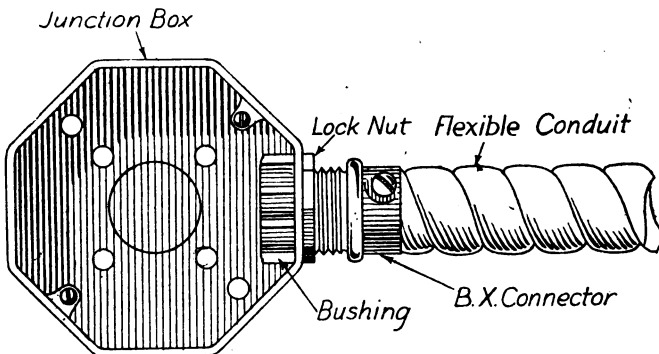


Fig. 40

Questions:

1. *When is it more desirable to use flexible conduit than flexible armored conductor?*
2. *Why is it necessary to support the bends in flexible conduit at several points around the bend?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Connecting flexible conduit to boxes and fittings

References:

Nelson, "Interior Electric Wiring and Estimating," p. 51.

Croft, "American Electrician's Handbook," p. 511.

Directions:

1. Run a standard armored cable box-connector over end of conduit after conduit has been sawed squarely to length and the inside of cut carefully reamed to remove burrs in the armor.

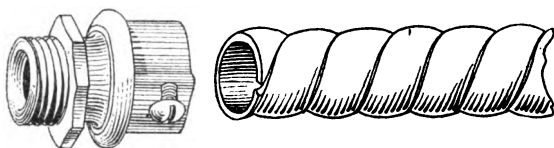


Fig. 41

2. Screw or clamp box-connector firmly to conduit, with conduit pushed into the connector as far as it will go. Several types of connectors are used and the method of fastening to conduit varies slightly with the several types.

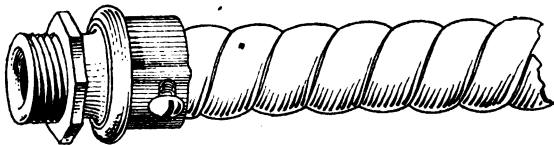


Fig. 42

3. Insert box-connector into box, in which a hole of suitable size has been drilled, or make a hole with a knock-out. The burr and enamel around the box hole should be removed to insure a good electrical contact between the box and the connector when locked up, in order that a thoroughly grounded conduit may result.

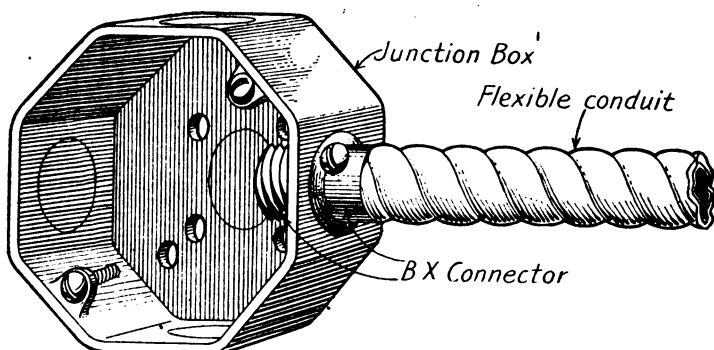


Fig. 43

4. Run a standard lock-nut over connector on inside of box and fasten securely with a pair of gas pliers.
Examine the installation for looseness.

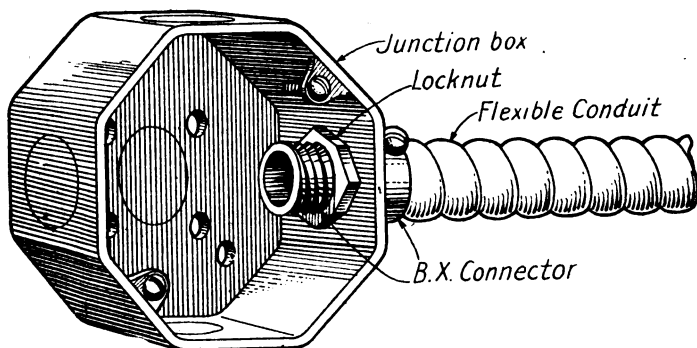


Fig. 44

Questions:

1. Why is it not necessary to use a bushing on inside of box?
2. Why is it necessary to make a rigid connection between the flexible conduit and the box?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Cutting flexible armored conductor

References:

Nelson, "Interior Electric Wiring and Estimating," p. 57.

Directions:

1. Mark point of cutting conductor, allowing six or eight inches extra at each end for splices.

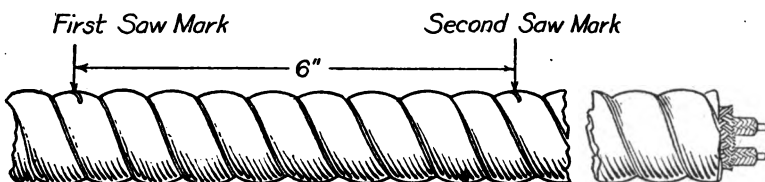


Fig 45

2. Clamp armored conductor in a flat-jawed vise with the point of cutting close to the edge of the vise jaws. If no vise is available, place the armored conductor on a box or stool, holding it as firmly as possible with one foot and the loose end with one hand.

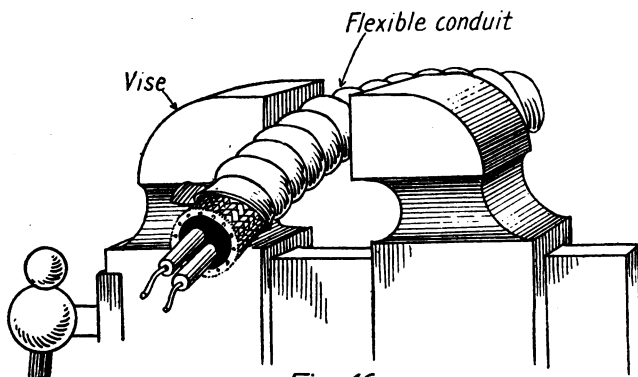
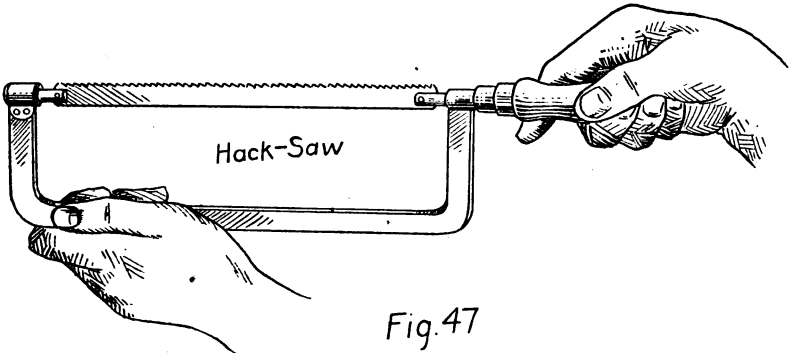


Fig 46

3. Inspect the hack-saw blade to see whether the teeth are badly broken or the blade loose in the frame. For cutting the armor of a flexible armored conductor a saw with fine teeth is desirable.



4. Saw squarely through the mark, beginning the cut in the center of one of the spirals. Care should be taken in cutting not to permit the saw to follow the edge of the spiral beneath, if a square job is desired. Usually it is not necessary to saw flexible armored conductor squarely, since the armor at each end is removed for splicing.

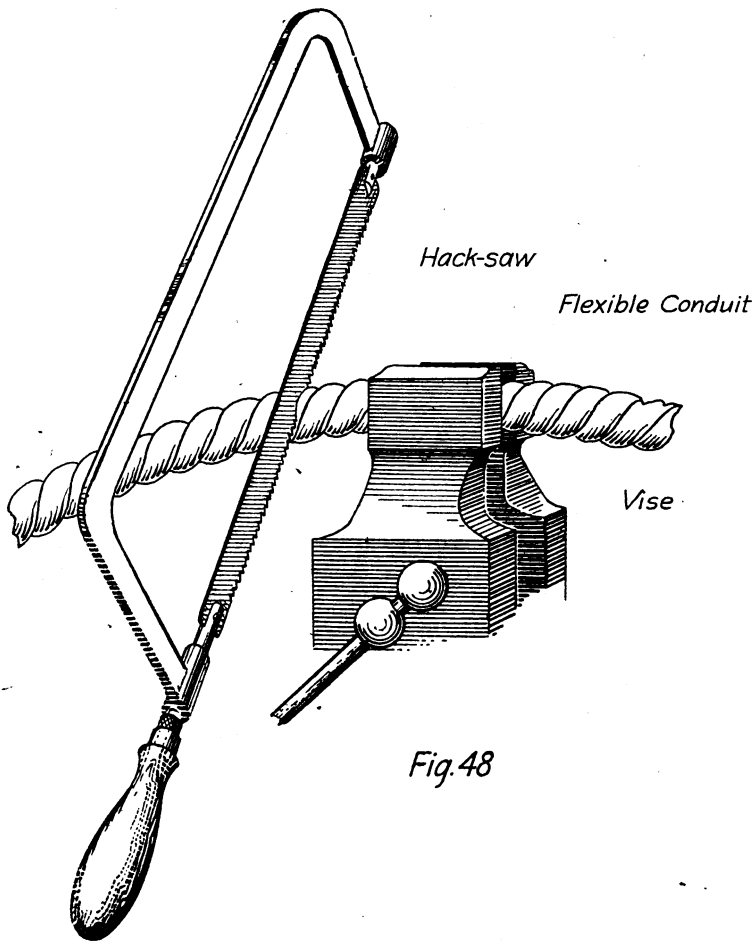


Fig.48

Questions:

1. What is the correct method of placing a saw in the frame? In what direction should the teeth point?
2. What other devices can be used for cutting flexible armored conductors?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Stripping armor from armored conductors

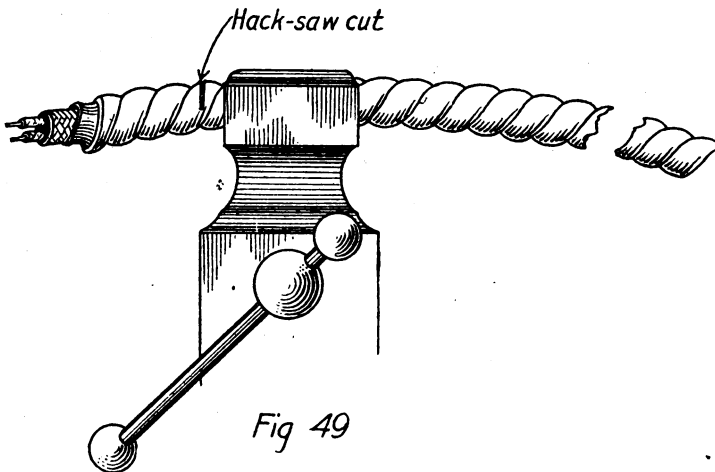
References:

Nelson, "Interior Electric Wiring and Estimating," p. 57.

Sharp, "Practical Electric Wiring," p. 128.

Directions:

1. Lay the flexible armored conductor over a box or in a vise, and cut into the outer spiral armor about six or eight inches from the end of the conductor. Use a fine toothed saw and do not cut entirely through the armor.



2. Grasp the armored conductor in both hands, and with the notched armor between the hands and pointing outward, bend the conductor backwards and forwards until the outer armor breaks. This will uncover the inner armor casing.

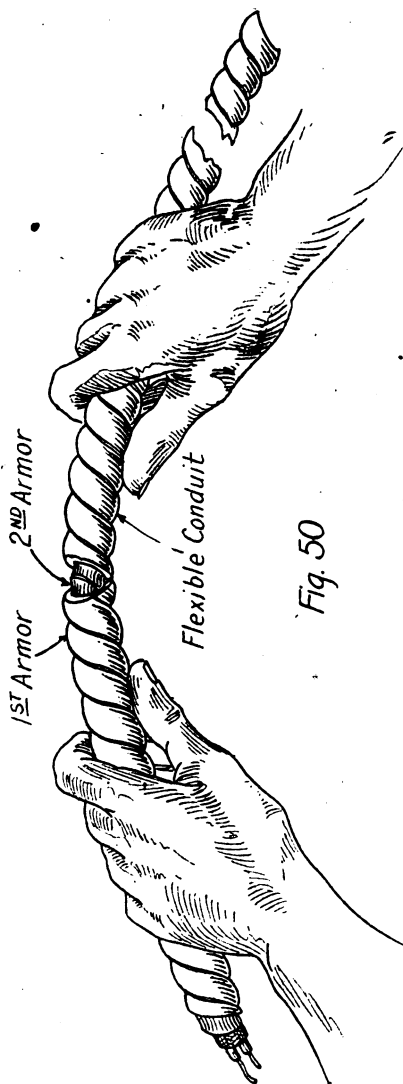


Fig. 50

3. Saw diagonally into the inner armor in the same manner as in cutting into the outer armor but use greater care in the cutting. Under no circumstances must the cut extend into the conductors or the conductor insulation. Make merely a notch in the second armor.

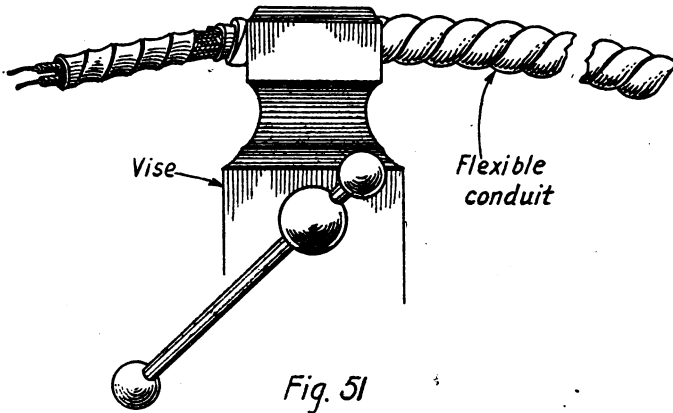


Fig. 51

4. Break the second armor in the same manner as breaking the first armor, and then slide or strip the armor from the conductor.

Examine the insulation at the point of cutting the armor to see if it has been damaged. If seriously damaged, the conductors should be cut off, and a new stripping made.

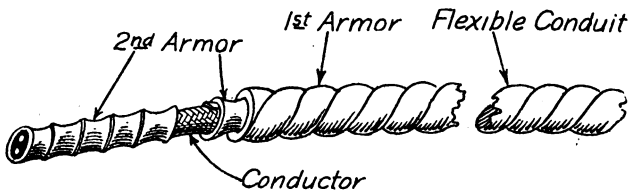


Fig. 52

Questions:

1. What other method of stripping BX is used?
2. Of what material is the armor made?
3. How is the surface of the armor treated?
4. How is the BX made moisture proof?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing flexible armored conductor (BX)

References:

Nelson, "Interior Wiring and Estimating," p. 54.

Sharp, "Practical Electric Wiring," p. 127.

Cook, "Interior Wiring," p. 226.

Croft, "Wiring of Finished Buildings," p. 113.

Directions:

1. Determine positions of outlet boxes and make provisions for fishing or placing armored conductor in position between walls or over exposed surfaces.

Make all runs continuous from outlet to outlet and use no couplings. All splices must be made within approved outlet boxes.

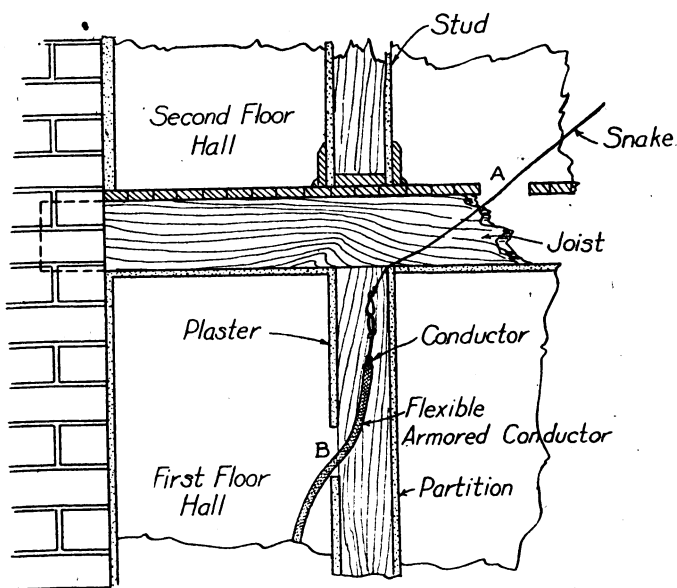


Fig. 53

2. Fasten securely with pipe straps all armored conductor when run exposed. When fished parallel to floor joists no supports are necessary. When run across joists, run armored conductor through holes bored through joists, and not in notches cut in joists, to avoid danger of penetrating armor with nails when floor is replaced.

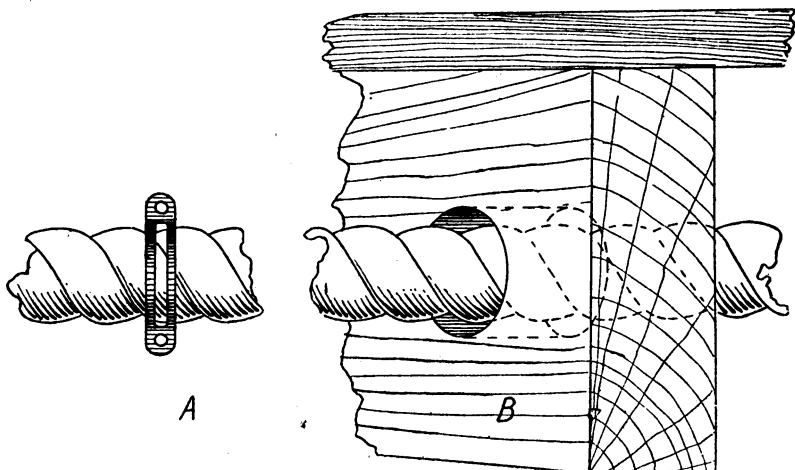


Fig. 54

3. Make all bends as gradual as possible to avoid opening the armor, as would occur at sharp bends. Secure the armored conductor at all exposed bends, and especially when it is used around machinery.

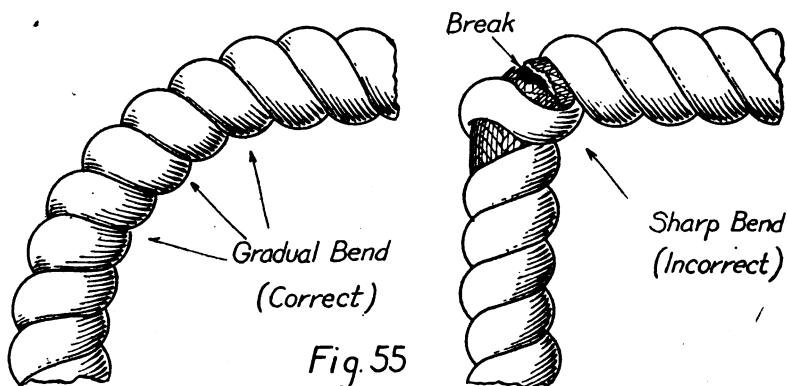


Fig. 55

4. Make all connections in standard boxes and with standard fittings. Ground the armor thoroughly.
Inspect installation for looseness.

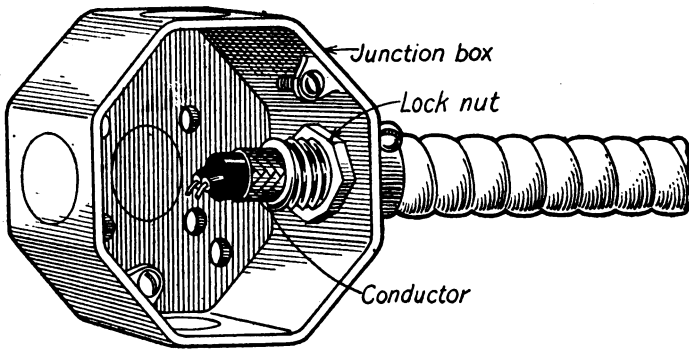


Fig. 56

Questions:

1. Why is it not permissible to splice armored conductor (BX)?
2. When is it advisable to use BXL instead of BX?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Connecting armored conductor to boxes and fittings

References:

Nelson, "Interior Electric Wiring and Estimating," p. 68.

Sharp, "Practical Electric Wiring," p. 128.

Croft, "Wiring of Finished Buildings," p. 115.

Croft, "American Electrician's Handbook," p. 511.

Directions:

1. Run a standard, approved armored conductor box-connector, usually known as a BX box-connector, over conductor, after sufficient armor has been removed for a splice in the box.

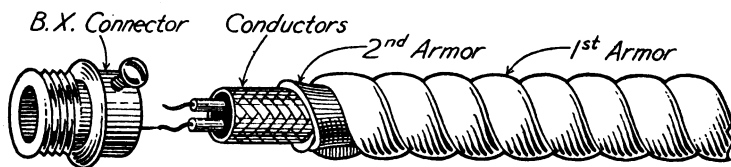


Fig. 57

2. Screw or clamp the box connector firmly on the armor, with the armor pushed into the connector as far as it will go. Several types of connectors are used and the method of fastening to armor varies slightly with the several types.

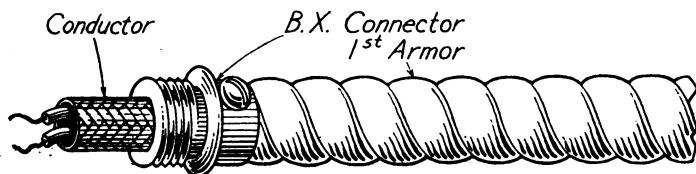


Fig. 58

3. Insert the box connector into box in which a hole of suitable size has been drilled or made with a knock-out. The burr and enamel around the box hole should be removed to insure a good electrical contact between the box and the connector when locked up, in order that a thoroughly grounded conduit may result.

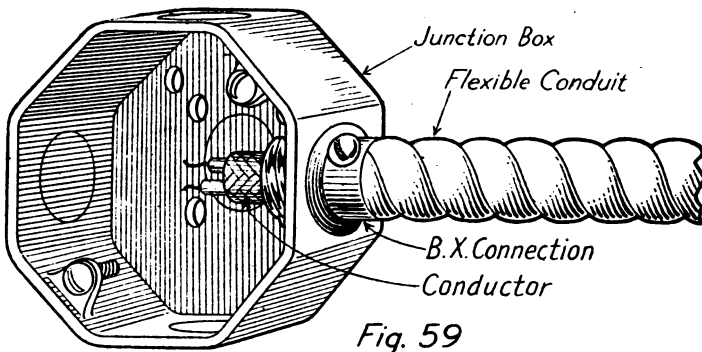


Fig. 59

4. Run a standard lock nut over connector on inside of box and fasten securely with a pair of gas pliers. Examine the installation for looseness.

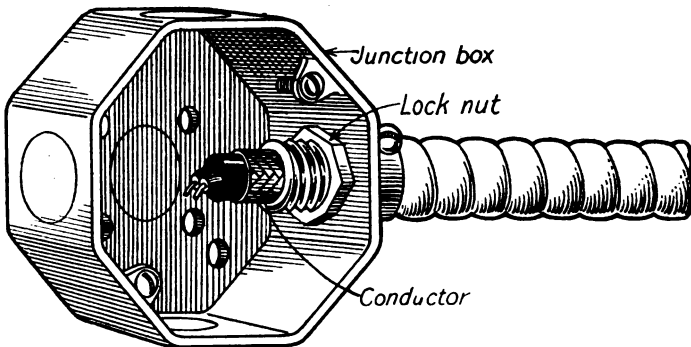


Fig. 60

Questions:

1. Why is it unnecessary to use a bushing on the inside of box when a BX box-connector is used?
2. What is the reason for fastening the BX to the box?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Cutting metal molding

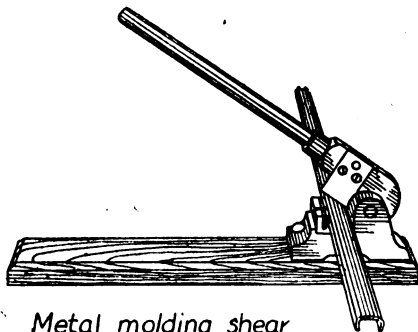
References:

Sharp, "Practical Electric Wiring," p. 133.

Croft, "American Electrician's Handbook," p. 470.

Directions:

1. Using metal molding shear. Mark molding at point to be cut and slide molding into slots of the die of the shear until the mark reaches one edge of the shear. The shear should be raised with the right hand while the molding is inserted into the slots below the shear with the left hand. If the piece of molding to be used is always held in the left hand and the mark on molding brought up to left side of cutter, there is no danger of cutting molding too short. Cut molding with one stroke of cutter handle.



Metal molding shear

Fig. 61

2. Using hack-saw. Inspect saw for broken teeth and loose blade. Use a saw with fine teeth. Mark molding at point to be cut and saw squarely through the mark, holding the molding under one foot on a box or stool. If a burr is left by the saw, remove it with a small file.

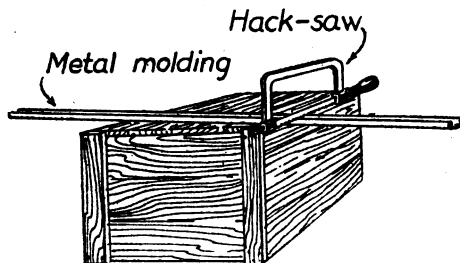


Fig. 62

3. Using a file. Mark molding at point to be cut. File a groove into the molding along the line used as a mark, using a sharp three-cornered file, making a V-groove completely around the molding.

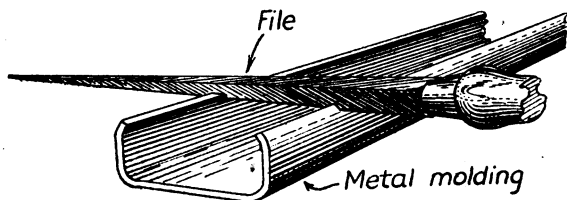


Fig. 63

4. Grasp the molding with both hands and break it apart at the groove.

Inspect the break for burrs or jagged edges and file off any burrs to make a smooth edge.

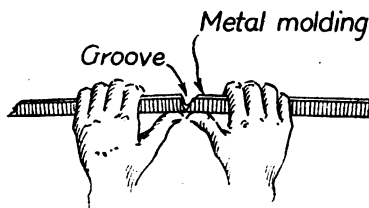


Fig. 64

Questions:

1. Can both base and capping be cut at one time in a metal molding shear?
2. Under what conditions should metal molding be cut with a file?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Slotting metal molding

References:

Sharp, "Practical Electric Wiring," p. 136.

Cook, "Interior Wiring," p. 231.

Directions:

1. Using metal molding punch. After molding has been cut to length, adjust the stop of the punch so that the molding will be punched at the desired point and insert molding into the punch against the stop.

Punch and slot the molding with one stroke of the punch handle. Do not punch the capping of the molding.

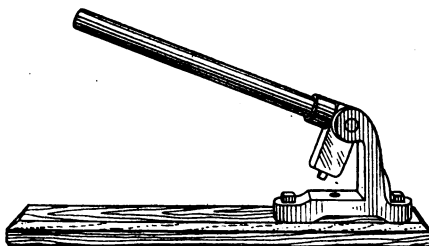


Fig. 65

2. Using drill and saw. After molding has been cut to length, punch a mark with a center punch in the inside of the molding, using a base coupling as a guide for the position of the hole to be drilled.

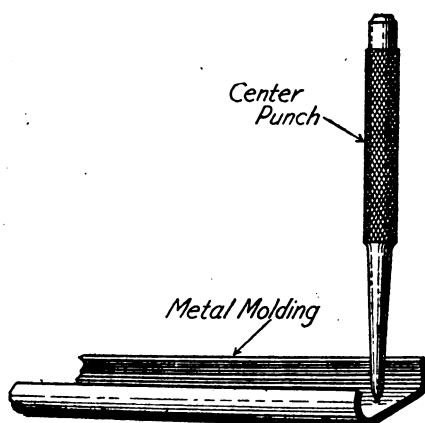


Fig. 66

3. Drill a hole through the center punch mark, using a standard twist drill large enough to receive the screw in the base coupling but not large enough for the head of the coupling screw to slip through. Countersink the hole slightly to receive the head of the coupling screw, using a drill slightly larger than the first drill.

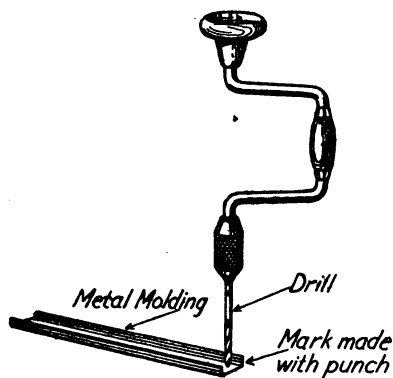


Fig. 67

4. Cut a slot from the end of the molding to the hole already drilled, making it just large enough to allow the coupling screw to slip through the slot into the hole at the end of the slot. Use a hack-saw with fine teeth and no dressing with a file will be necessary after the slot is cut.

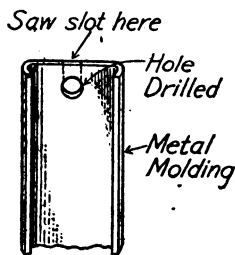


Fig. 68

Questions:

1. *Should the molding curve upward or downward in the punch?*
2. *Is it necessary to connect the capping in the same manner as the base?*
3. *What is the purpose of connecting the base with couplings?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

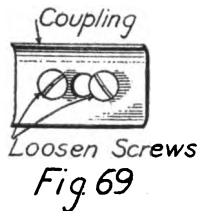
Coupling metal molding .

References:

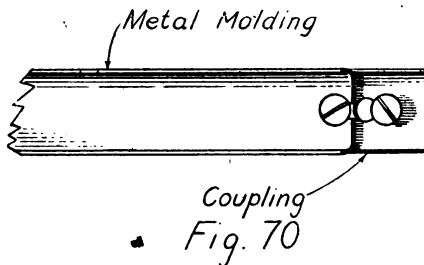
Sharp, "Practical Electric Wiring," p. 135.

Directions:

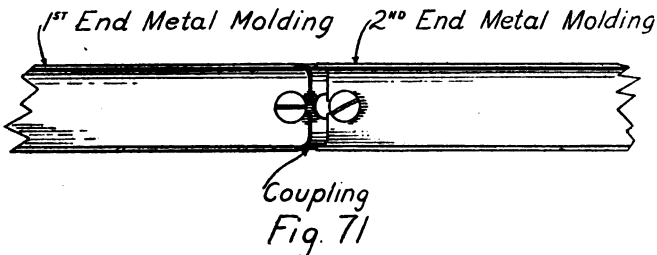
1. Loosen the screws in the coupling, but do not try to remove them from it.



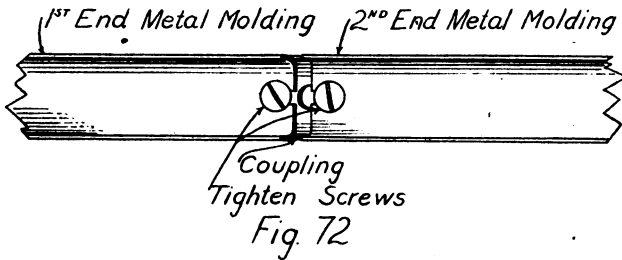
2. Slip the coupling into the slot of the last section of metal molding base installed.



3. Slip into the coupling the new section of the metal molding base to be added, with the slot in the end of the new section under the second screw in the coupling.



4. Tighten screws in coupling securely, and test for looseness.



Questions:

1. Why is it necessary to couple or bond the two sections carefully?
2. Why is it unnecessary to couple the capping?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Bending metal molding

References:

Croft, "American Electrician's Handbook," p. 470.

Cook, "Interior Wiring," p. 231.

Directions:

1. Select a section of metal molding base and metal molding capping. Snap the capping over the base at the point of bending and about two feet on each side of the bend.

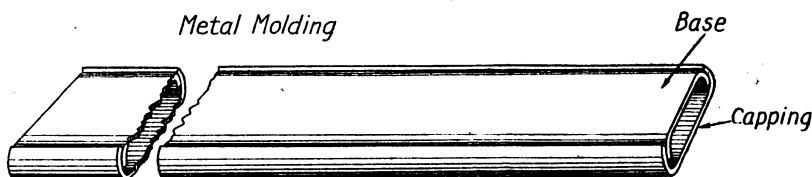
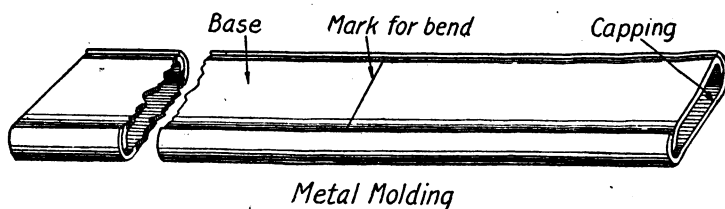


Fig 73

2. Mark a point on the capping or base which will be the center of the bend. Flatwise bends are more common than edgewise bends, since standard fittings at different angles are used for edgewise bends. Flatwise bends are usually made in offsets, the maximum offset usually being from four to five inches. For right-angle bends, fittings should be used.



Metal Molding

Fig. 74

3. Bend molding for a close bend by inserting one end of molding into end of a radiator, between two vertical risers of the end radiator section, and pulling molding gradually into shape. The corner of a box or bench can also be used for forming a close bend.

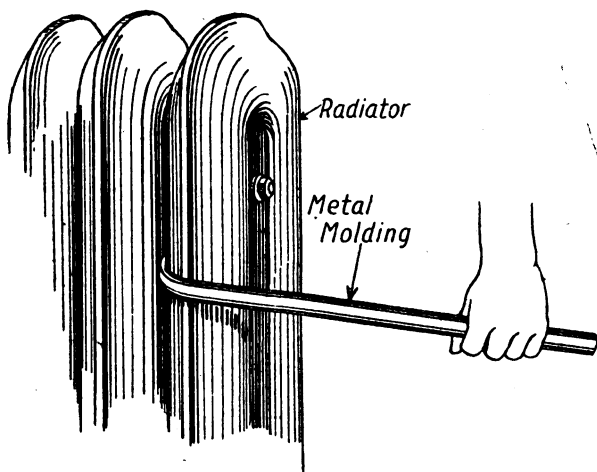


Fig. 75

4. Bend molding for a gradual bend by grasping it in both hands and bending it around a round post or large pipe.

After molding has been bent into shape the capping should be removed to permit the installation of the base.

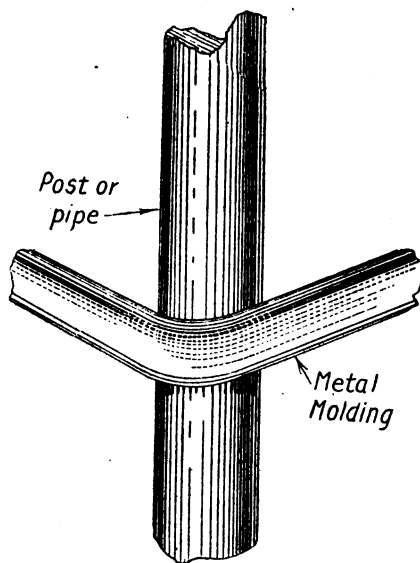


Fig. 76

Questions:

1. *What is the difficulty in making edgewise bends?*
2. *Why is the bending of metal molding limited to small offsets?*
3. *Why is it necessary to use more elbow fittings with metal molding than with standard rigid conduit?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Mitering an edgewise turn with metal molding

References:

Croft, "American Electrician's Handbook," p. 470.

Sharp, "Practical Electric Wiring," p. 137.

Directions:

1. Cut a V-notch into the edge of metal molding base, leaving an edge on opposite side of molding intact. For a right-angle bend, the V must be cut with an angle of 45 degrees on each side of the center of the turn. A hack-saw with fine teeth should be used.

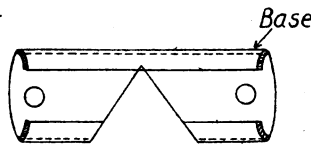


Fig. 77

2. Bend the metal molding base carefully until the sides of the V-notch are brought together.

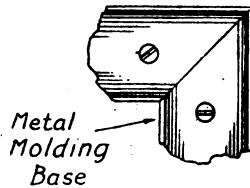


Fig 78

3. Lay off a V on the metal molding capping of the same size as the V-notch cut into the metal molding base. Saw along the sides of the V on the capping, cutting the capping entirely through on both sides of the V. If a right-angle turn is made, two pieces of capping can be mitered together by using a combination square, laying off a line at an angle of 45 degrees at the end of the molding for cutting.

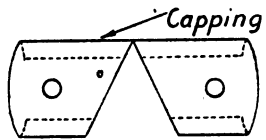


Fig. 79

4. Snap each piece of capping over the metal molding base and bring the two pieces of capping together tightly by driving them together with a hammer at the opposite ends of the capping.

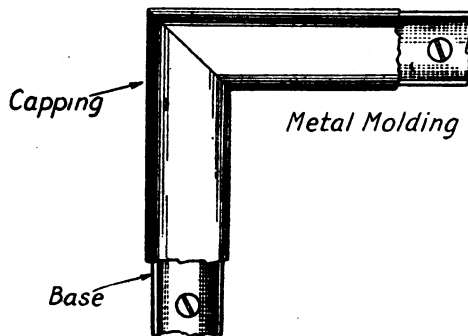


Fig. 80

Questions :

1. Why is it necessary to make base continuous by, not cutting the V-notch entirely through the base?
2. When would metal molding be mitered and standard elbows not used?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Mitering a flatwise bend with metal molding

References:

Croft, "Wiring for Light and Power," p. 318.

Croft, "American Electrician's Handbook," p. 470.

Directions:

1. For an outside mitered bend cut squarely into the metal molding base at point marked for the bend, but do not cut into the bottom of the base. The cutting is limited merely to the sides of the metal molding base.

For an inside mitered bend, cut a V-notch into the base, the angle of which depends upon the amount of turn made. For a right-angle turn, the V should be 45 degrees on each side of the center of the bend.

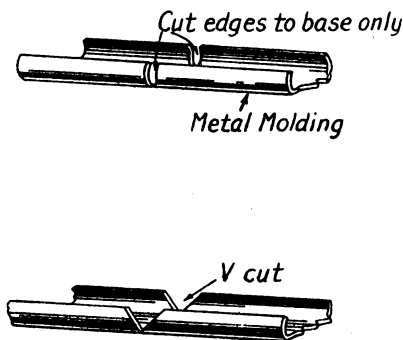


Fig. 81

2. Bend the metal molding base carefully into shape, fitting the bend to the surface to which the molding will be attached.

For an inside mitered bend the sides of the V-notch must be brought together tightly.

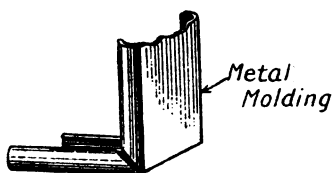


Fig. 82

3. For an outside mitered bend cut the capping into two pieces, with the ends cut an angle to fit the bend of the base. For a right-angle bend the angle of the capping should be 45 degrees.

For an inside bend the capping is cut squarely into two pieces.

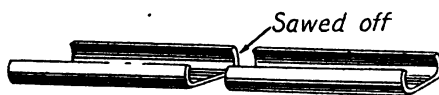


Fig. 83

4. Snap the capping over the base, and drive the two pieces together at the bend by tapping them together with a hammer.

Elbow covers can be used over mitered bends, if it is not desirable to miter the capping.

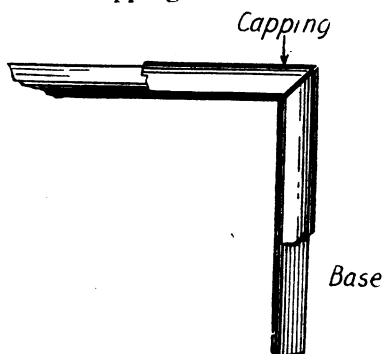


Fig. 84

Questions:

1. Why should the metal molding not be cut through at the corner?
2. Why is it more desirable to miter the molding than to use a standard elbow fitting?

ELECTRICAL DEPARTMENT
INTERIOR WIRING
Installing metal molding

References:

Nelson, "Interior Electric Wiring and Estimating," p. 27.

Sharp, "Practical Electric Wiring," p. 132.

Croft, "American Electrician's Handbook," p. 470.

Directions:

1. Install metal molding base between outlets, beginning with the first outlet box. Each outlet box should be installed as it is reached.

Attach the molding base to the surface over which it is run by means of flat-head screws, toggle bolts, expansion bolts, or other forms of hangers, depending upon conditions.

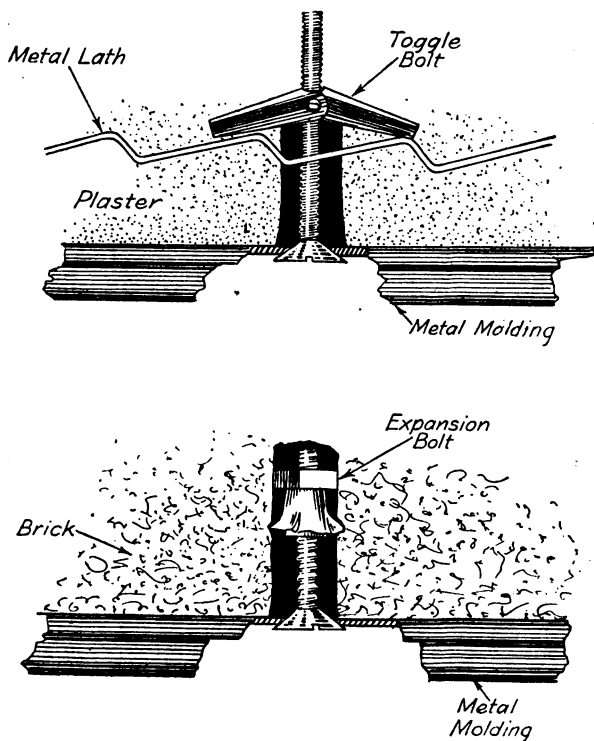


Fig. 85

2. Make all bends to fit close to the corners of walls and ceilings, using standard metal molding fittings, such as elbows, or by mitering. All crosses, tees, taps, ceiling outlets, etc., must be made with approved metal molding fittings.

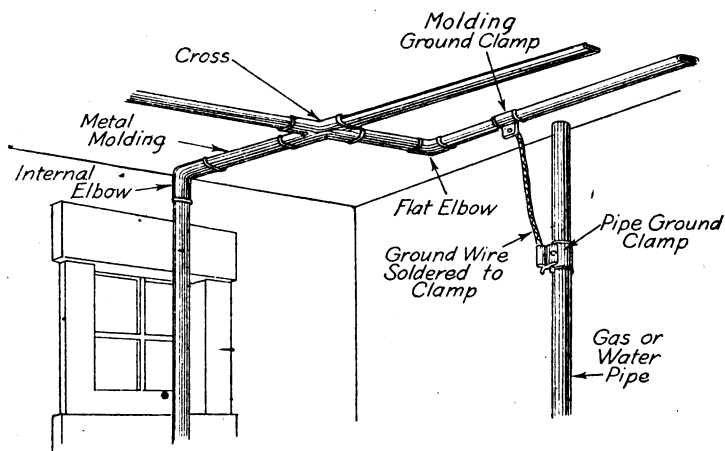


Fig. 86

3. Insert ends of conductors into outlet box, allowing enough for splices. Lay conductors into capping, keeping them from twisting in the raceway.

Make no splice in conductors except at outlet or junction boxes.

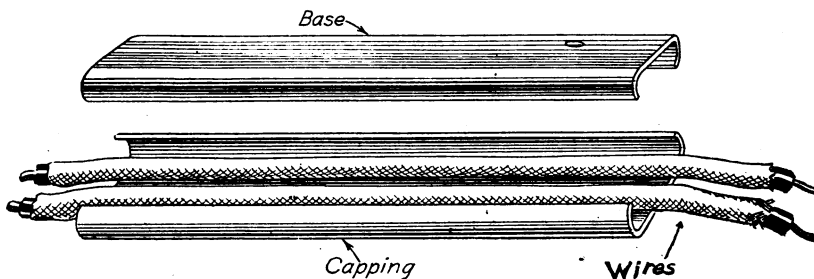


Fig. 87

4. Snap one end of capping into place near outlet box and gradually snap entire length into place with a hammer. Be careful to avoid injury to insulation of conductors by pinching conductors between capping and base.

The capping should overlap the joints in the base.
Ground molding, if necessary.

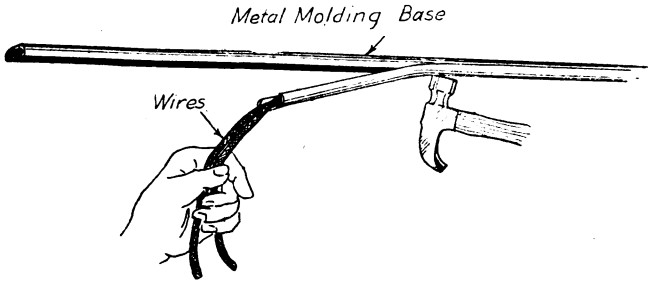


Fig. 88

Questions:

1. *Why is it advisable to overlap the joints in the base with the capping?*
2. *Why are splices in the molding not approved?*
3. *Why is metal molding not approved for concealed work?*
4. *How is metal molding passed between floors or partitions?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Connecting metal molding to boxes

References:

Nelson, "Interior Electric Wiring and Estimating," p. 30.

Directions:

1. Fasten lower half of bushing to box by slipping the slotted end of the bushing under the small screw in the outlet box opposite the knock-out through which the conductors will pass. The knock-out is in the cover, which is attached after molding and conductors are in place.

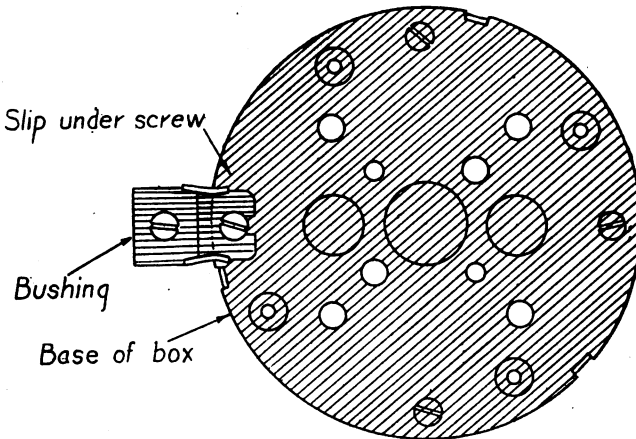


Fig. 89

2. Fasten metal molding base to the opposite end of bushing by slipping the slotted end of the molding under the screw in the bushing.

Run conductors into molding, allowing sufficient length for splices in the box. Snap capping of molding in place, bringing end of capping in line with end of molding.

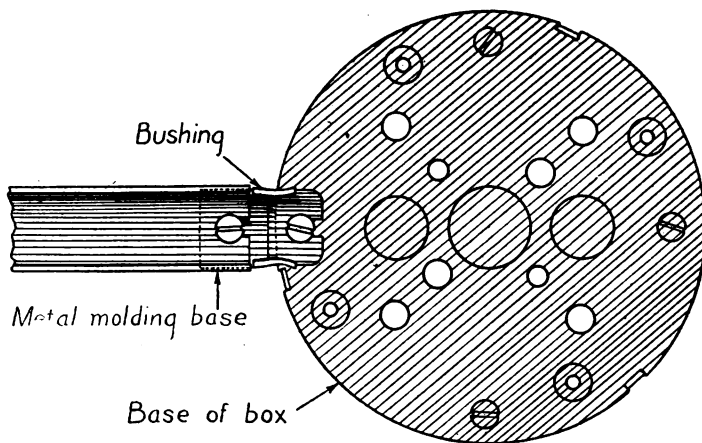


Fig. 90

3. Snap the top half of bushing over the metal molding capping so that the flange of the bushing will come just inside of the box cover, when cover is installed.

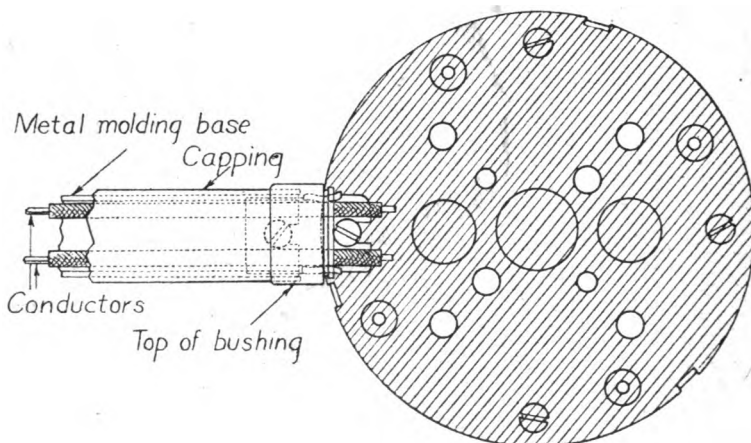
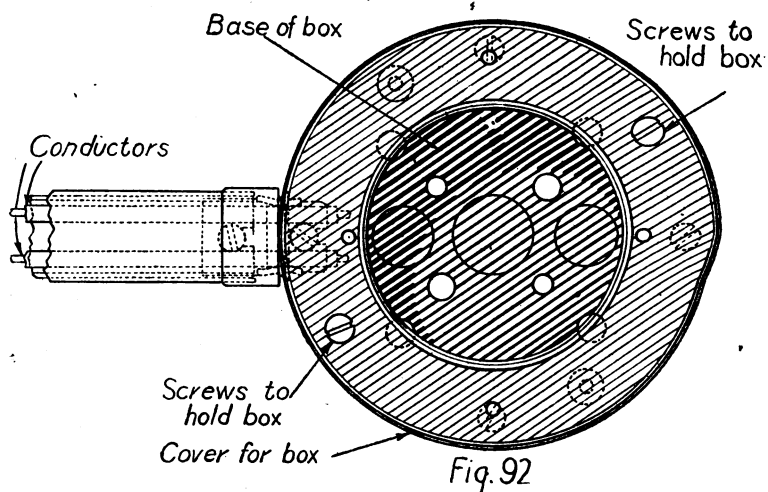


Fig. 91

4. With pair of pliers break out the necessary knock-out. Slip the cover over the box plate and molding, taking care that flange of bushing comes inside the cover. Fasten cover in place with screws driven into the plate beneath.



Questions:

1. *What is the purpose of the top half of the bushing?*
2. *Why is it not permissible to attach molding to box without a bushing?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Cutting and reaming ovalduct

References:

- Croft, "Wiring of Finished Buildings," p. 112.
- Nelson, "Interior Electric Wiring and Estimating," p. 32.

Directions:

1. Clamp the ovalduct in a flat-jaw vise, being very careful not to square or dent the ovalduct out of shape.

If no vise is available, hold the ovalduct over the edge of a box, grasping it in one hand or holding it firmly with one foot.

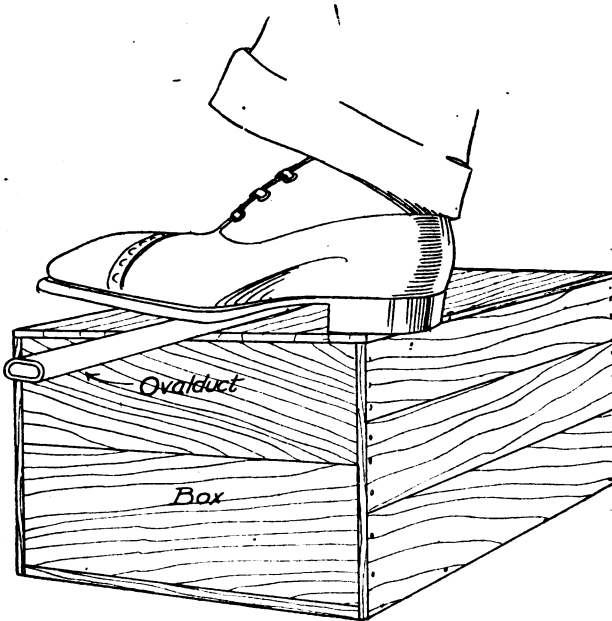


Fig 93

2. Examine the saw to see whether the teeth are badly broken, or whether the blade is loose in the frame.

For cutting ovalduct, use a saw with fine teeth, since a coarse saw will leave a burr which will require considerable work in reaming.

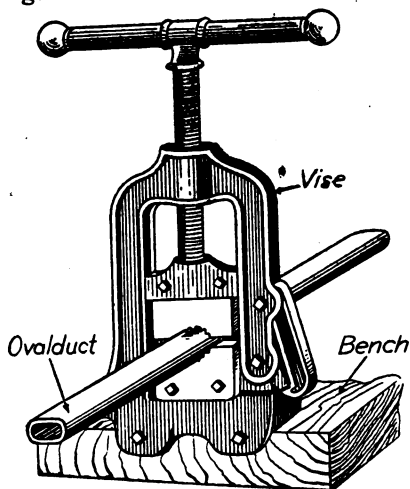


Fig. 94

3. Saw squarely through the mark, allowing for connections by measuring from connection to connection.

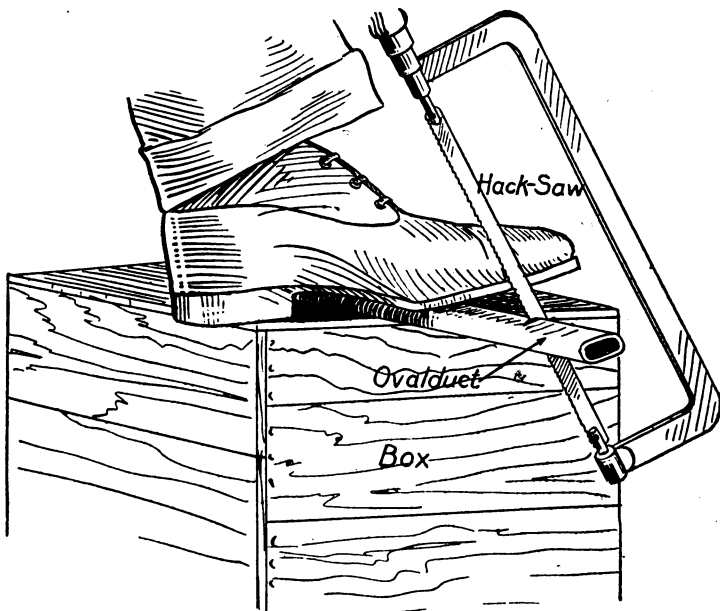


Fig. 95

4. Use a rat-tail file to ream out the burrs left by the saw. Do not file too much, since a thin edge may cut the conductor and excessive filing will weaken the thin wall of the ovalduct.

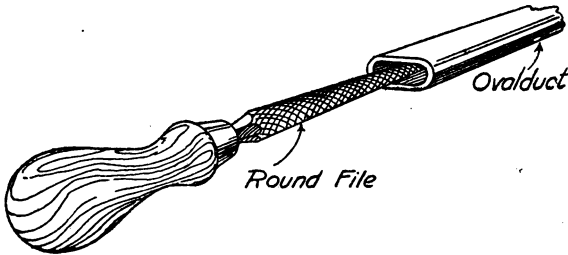


Fig 96

Questions:

1. Why is it difficult to saw thin tubing with a coarse hack-saw?
2. Can a standard burring reamer be used for reaming ovalduct?

ELECTRICAL DEPARTMENT
INTERIOR WIRING
Bending Ovalduct

References:

Croft, "Wiring of Finished Buildings," p. 112.

Nelson, "Interior Electric Wiring and Estimating," p. 32.

Directions:

1. Bend the ovalduct over the knee, placing the round edge against the knee. Grip the ovalduct with both hands, the distance between the hands depending upon the radius of the bend to be made, and pull it into shape.

Be careful to prevent the ovalduct from turning over and bending on the flat side. Usually the complete bend can be made with one sweep of the hands.

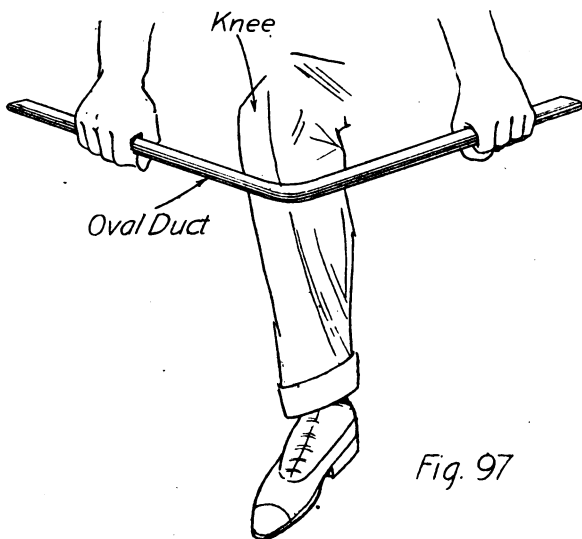


Fig. 97

2. Place the round edge of the ovalduct against a pipe or post and bend it. Grip the ovalduct with both hands, the distance between the hands depending upon the radius of the bend to be made, and pull or push it into shape. Be careful to prevent it from turning over while bending.

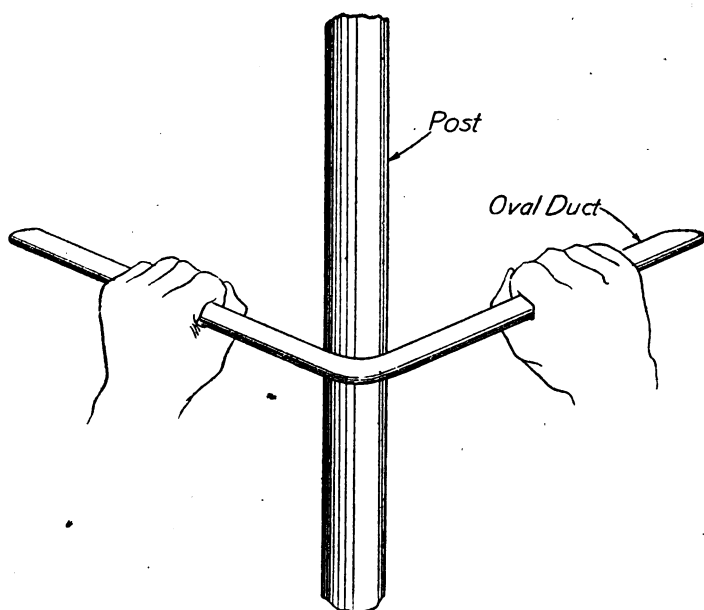


Fig. 98

3. When close bends are required bend the ovalduct between the loops of a radiator. Stick one end of the ovalduct into the space between two radiator coils near the center of a coil.

Bring the ovalduct into shape by pulling carefully on one end of it, taking care not to make the bend too sharp and thus kink the ovalduct.

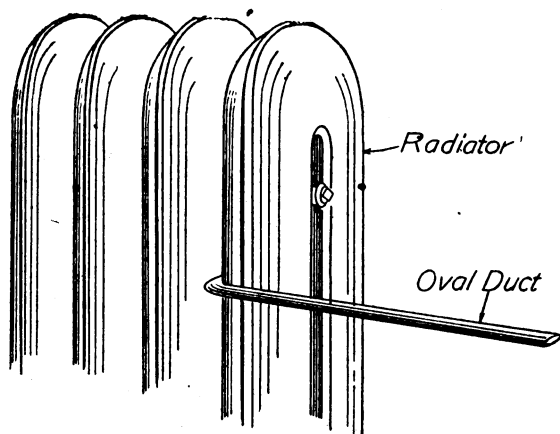


Fig 99

4. When close bends are required use a vise to bend ovalduct. Clamp one end of the ovalduct in a flat-jaw vise, being careful not to dent it. Bend the duct a small amount, move it outward from the vise jaws slightly, bend a little more, move it again, and so on, until the desired bend is made. There is great danger of kinking the duct, and it should be moved frequently during the bending process.

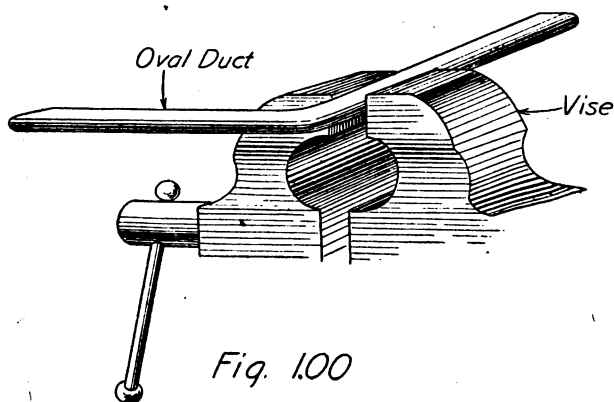


Fig. 100

Questions:

1. Why is it not advisable to bend ovalduct flatwise instead of edgewise?
2. If the ovalduct has a tendency to twist flatwise when an edgewise bend is made, how is the twist removed?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Coupling Ovalduct

References:

Croft, "Wiring of Finished Buildings," p. 112.

Nelson, "Interior Electric Wiring and Estimating," p. 32.

Directions:

1. Loosen the screws of a standard ovalduct coupling, taking care not to unscrew the short screws entirely from the nuts.

*Oval duct
coupling*



Fig. 101

2. Slip the loosened coupling over the end of the ovalduct, pushing the coupling back far enough for the end of the duct to show.

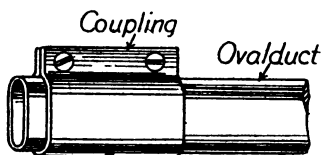


Fig. 102

3. Bring together the ends of the two sections of ovalduct to be coupled, and slip the coupling over the joint so that one-half of the coupling is over each section.

Be sure that the ovalduct sections touch each other.

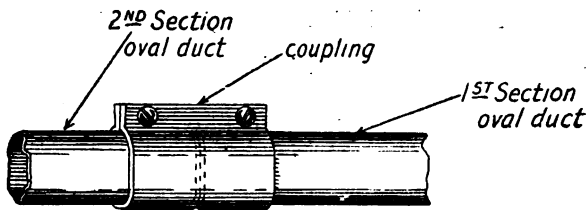


Fig. 103

4. Clamp the coupling in place by tightening up the screws in it.

Under no circumstances must a splice be made in the conductors pulled into the ovalduct, except at junction or outlet boxes.

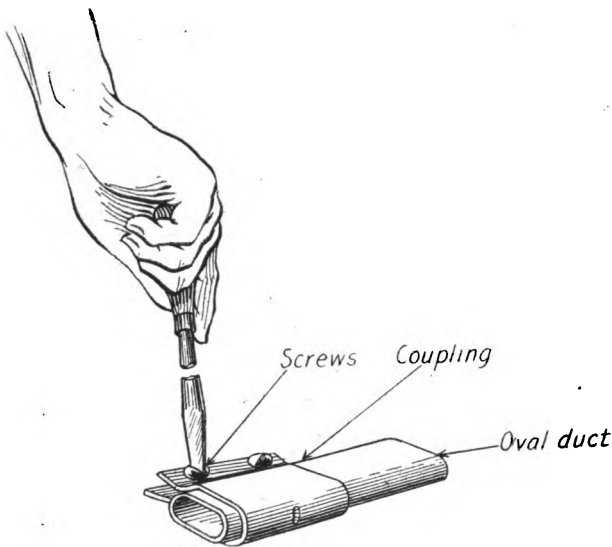


Fig. 104

Questions:

1. Why is it necessary to make a good connection between adjoining sections of ovalduct?
2. What is the best method of installing a coupling? Should the heads of the screws be outward or should the nuts be outward?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing ovalduct

References:

Croft, "Wiring of Finished Buildings," p. 112.

Nelson, "Interior Electric Wiring and Estimating," p. 32.

Directions:

1. Determine positions of outlet and junction boxes and install them. Then mark two lines of plastered surface between boxes, using a piece of ovalduct as a straight edge.

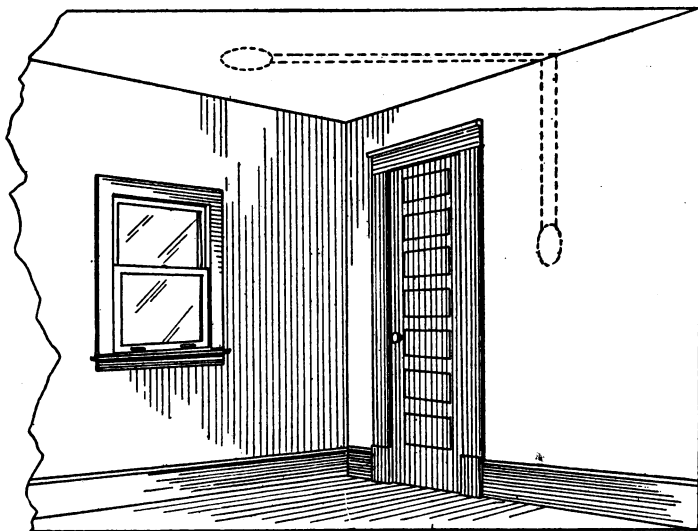


Fig-105

2. Cut along the lines with a sharp cold-chisel with a long handle. Then with the coldchisel chip away the plaster between the lines, placing the chisel cross-wise between the lines already chipped.

Remove both coatings of plaster and, if the channel thus formed is not deep enough to conceal the ovalduct, chip into the tile below the plaster. The channel should be deep enough to permit a coating of plaster over the duct of $\frac{1}{8}$ inch or more.

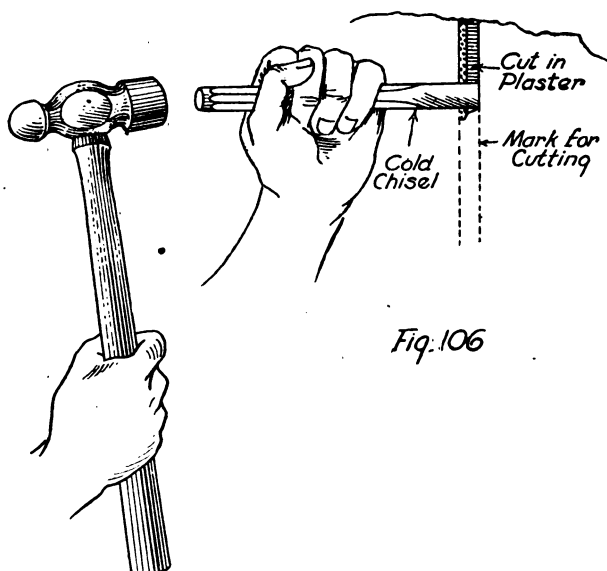


Fig. 106

3. Push conductor through the ovalduct section to be installed. The length of the conductors must be sufficient to reach from outlet to outlet without splicing. Only one section of duct need be installed at one time, the excess lengths of conductors hanging out of the end of the last section of ovalduct.

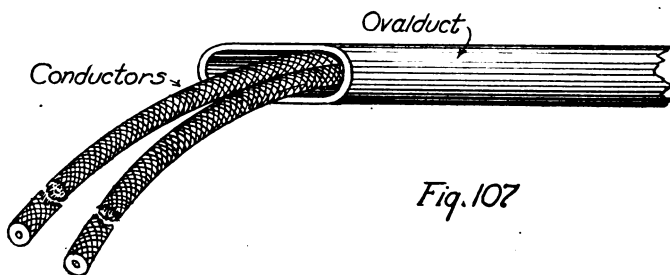


Fig. 107

4. Fasten the ovalduct to the tile surface by punching a small hole on each side of the duct and fishing a small tie wire, usually a piece of No. 14 bare copper wire, looping the tie around the duct, twisting the ends together at the side of the duct, not on top of the duct.

The spacing between the tie wires is determined by local conditions.

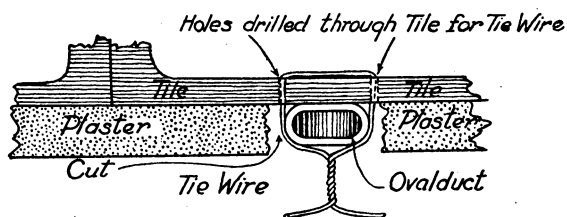


Fig. 108

Questions:

1. *How are allowances made in the channel for couplings?*
2. *Why is it impossible to install a complete ovalduct system as is done with rigid conduit, and fish the conductors through the duct after the installation is completed?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Connecting ovalduct to boxes

References:

Nelson, "Interior Electric Wiring and Estimating," p. 32.

Croft, "Wiring of Finished Buildings," p. 112.

Directions:

1. Slip the ovalduct box bushing through the knock-out in the box, starting the bushing through the box from the inside. Place the large end of the key-hole slot in the bushing over the screw in the bottom of the box, opposite the knock-out, and loosen the screw.

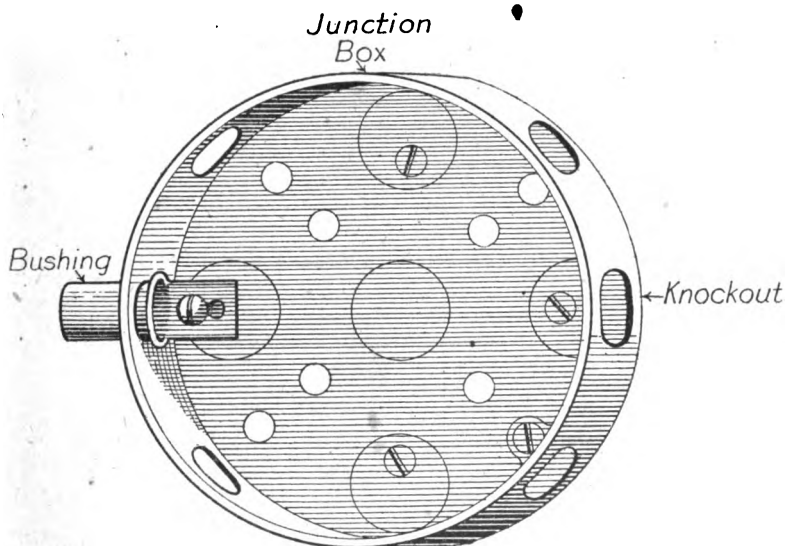


Fig. 109

2. Push the bushing until the flange rests against the inside of the box. Then fasten the bushing in place by screwing up tight the set screw in the key-hole slot.

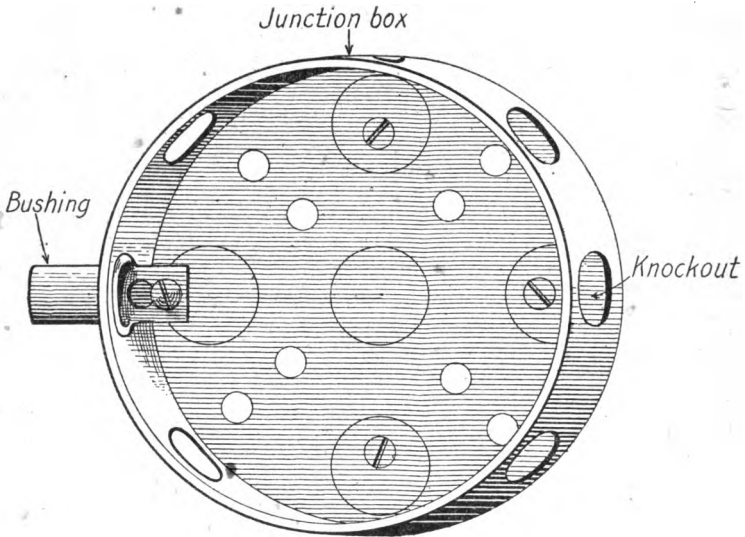


Fig. II0

3. Slip a Standard Ovalduct coupling over end of Ovalduct.

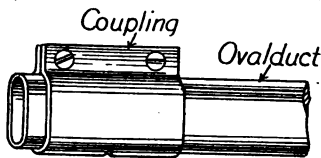


Fig. III

4. Insert conductors through the bushing. Push the ovalduct against the end of the bushing, and slip the coupling back against the box and over the bushing.

Tighten the coupling screws securely, and test for looseness.

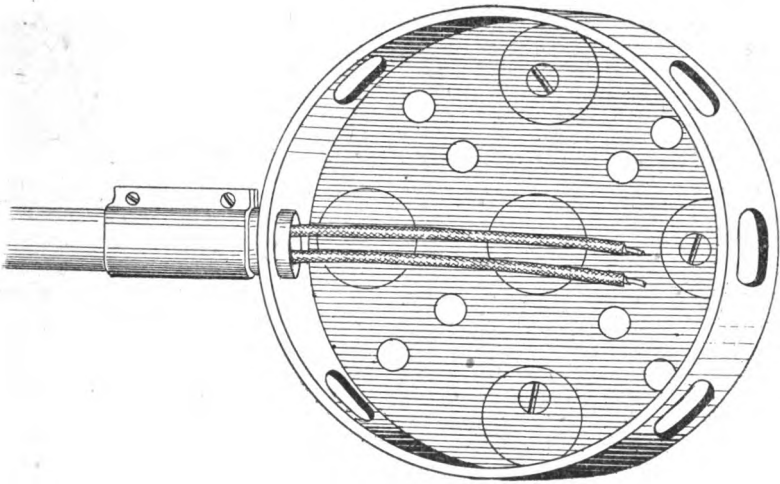


Fig. 112

Questions:

1. *Why is it necessary to use a bushing for connecting oval duct to a box?*
2. *Why is it best to locate the set-screw in the box after the bushing is inserted?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Cutting wooden molding

References:

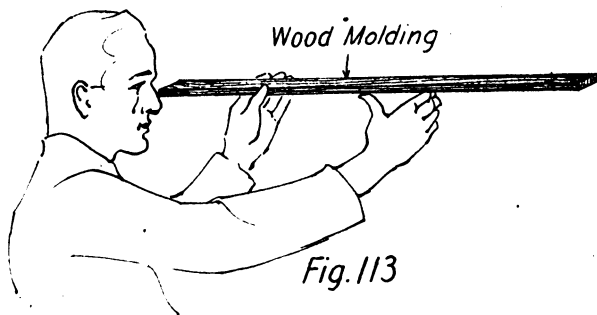
Croft, "American Electrician's Handbook," p. 457.

Cook, "Interior Wiring," p. 232.

Sharp, "Practical Electric Wiring," p. 70.

Directions:

1. Examine molding for warp, cracks, or other damages. Inspect capping in same manner.



2. Draw a pencil line, or scratch molding with a small nail, at point to be cut, using a small square when molding must be carefully joined.

While in some places it is not necessary to square the cut accurately, it is a good plan to make all joints meet squarely to make a satisfactory job.

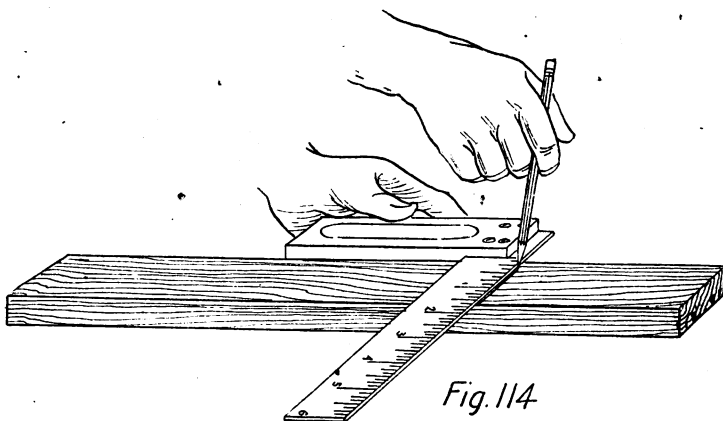


Fig. 114

3. Saw squarely through the line, usually drawn on the back of the molding, using a fine saw, if possible, to prevent tearing at the edge of the molding. Hold the molding on a box or bench, either in a vise or under one foot, supporting the free end with one hand.

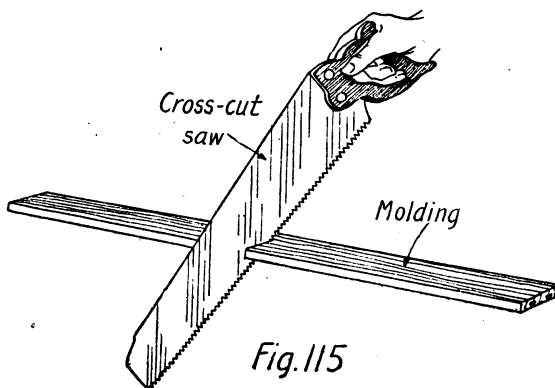


Fig. 115

4. Saw carefully when finishing the cut, and support the molding so that it will not break off and make a ragged cut that splinters and makes an unsightly job.

In special places, requiring unusually good work, a back-saw can be used in an adjustable miter box.

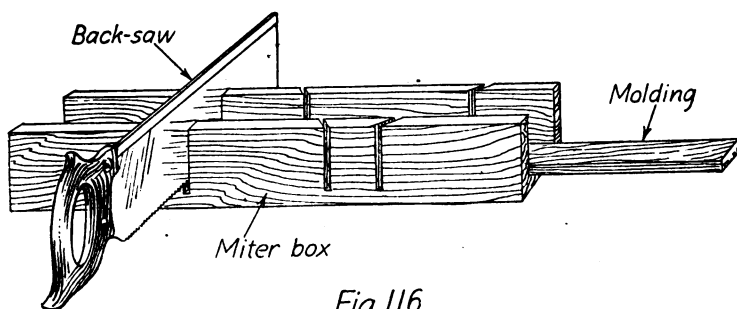


Fig. 116

Questions:

1. *What kind of saw would be used for soft wood? For hard wood?*
2. *Should a piece of molding be used, if the tongue between the grooves is broken away from the molding?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Bending wooden molding

References:

Croft, "American Electrician's Handbook," p. 461.

Directions:

1. Mark off, on back of molding, a distance equal to amount of bend, and at a point on the molding which will strike the bend when in place.

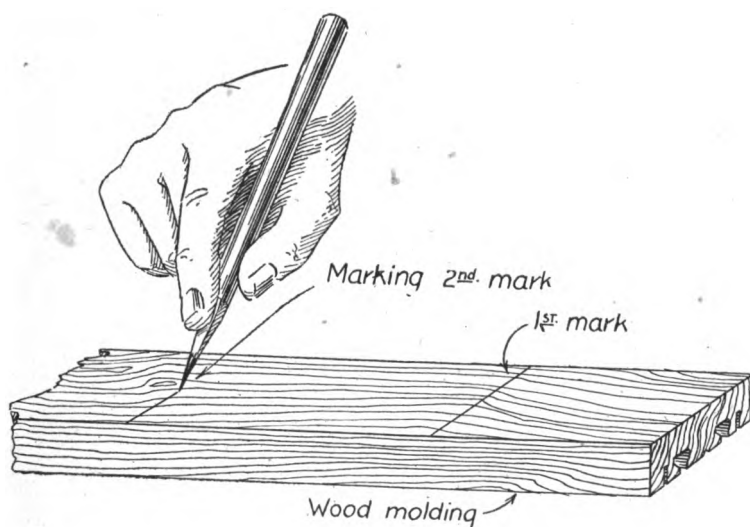


Fig. 117

2. Within the area marked above, make a number of saw cuts across the back of the molding extending at least half-way into the molding. The number of cuts, and their nearness to each other depends upon the radius of the bend and the amount of bending to be done, and can only be determined by trying to bend the molding without breaking it.

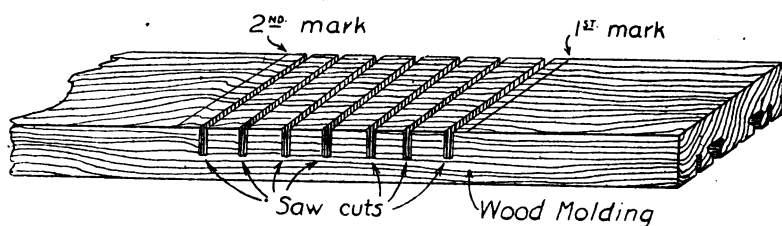


Fig. 118

3. If necessary, wet the molding with water to assist the bending. To hold the molding firmly in shape, after installation, fill the saw-cuts with cabinet-maker's glue just before installing the molding in position.

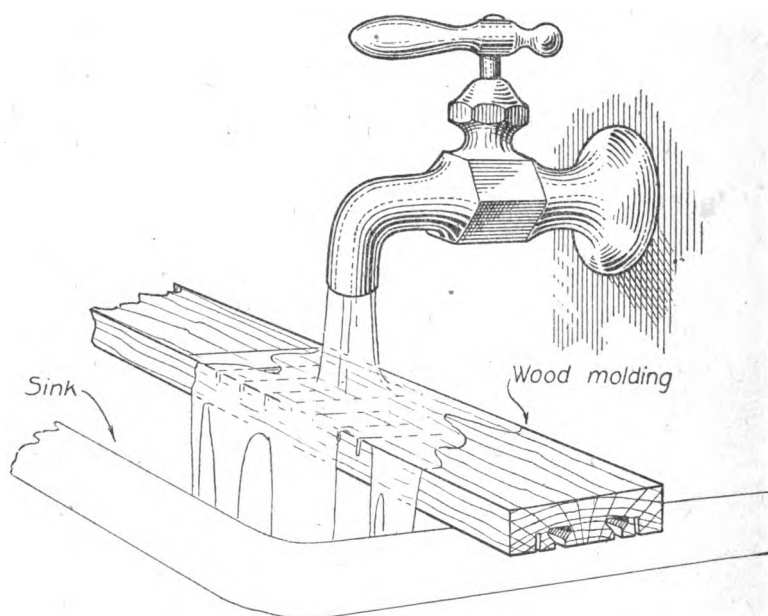


Fig. 119

4. Secure the molding to the underlying surface, using about twice as many screws or nails over a given length as would be used in a straight run.

The capping will usually bend without any treatment, except possibly wetting it. This is not desirable, since the base should be impregnated with some water-proofing material, such as shellac.

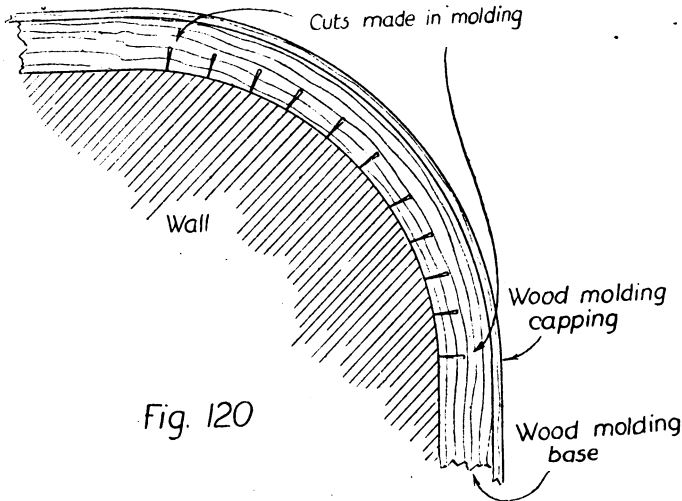


Fig. 120

Questions:

1. *How does the glue, placed in the saw-cuts, help to retain the curved shape of the molding?*
2. *Will the wetting of the molding help, if the molding is shel-laced at the bend before it is used?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Mitering wooden molding

References:

Croft, "American Electrician's Handbook," p. 460.

Sharp, "Practical Electric Wiring," p. 72.

Directions:

1. Lay out, with a miter-combination square, a line at the end of each piece of molding to be joined by mitering. Use a pencil or a small nail to scratch lines for cutting.

If a miter-box or iron miter frame is at hand, use it with a fine saw or back saw.

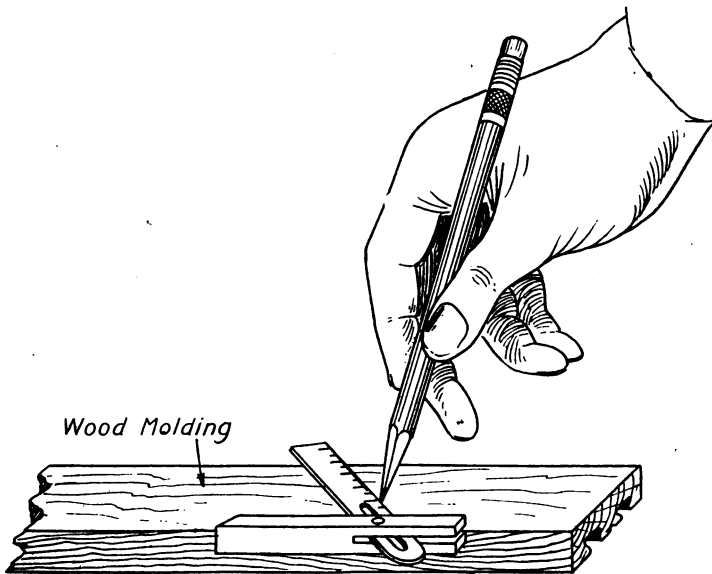
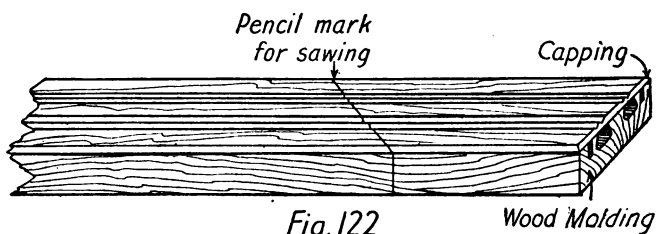
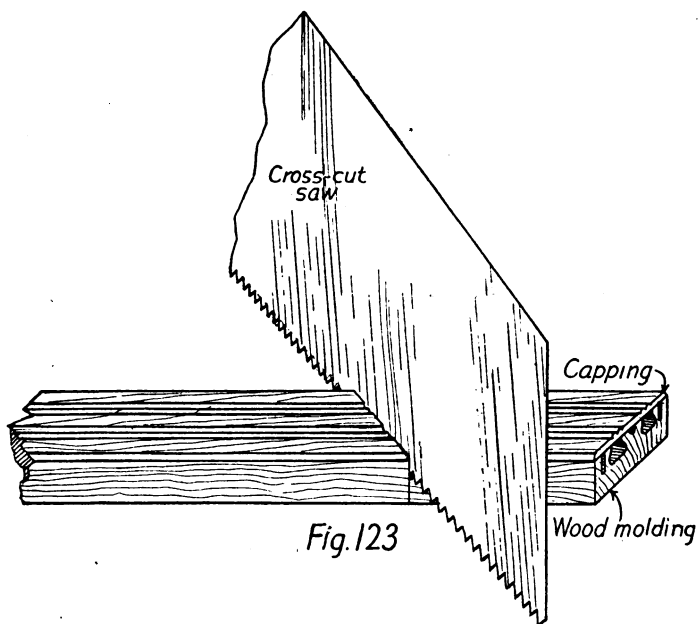


Fig. 121

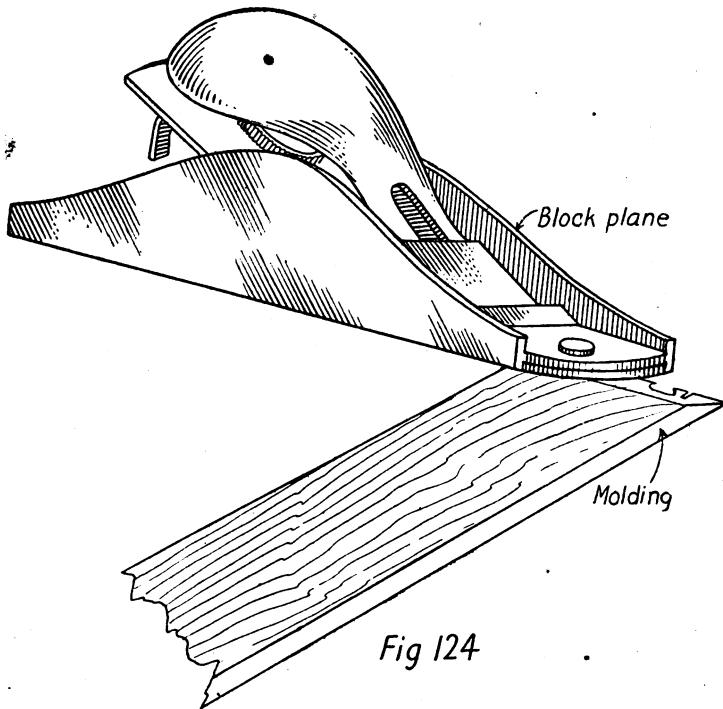
2. If possible, lay the capping over the molding when sawing, since a better job of mitering results than if the capping is mitered separately.



3. Saw squarely through the mark, keeping the saw square with the top of the molding so that the cut will not slant and make an open joint.



4. Try the joint, and if necessary, miter the joint carefully, especially the capping, using a small block plane. If the base does not miter well, the joint should be planed to prevent an opening behind the capping.



Questions:

1. *When mitering from one surface to another, as from ceiling to side wall, is it necessary to miter the base for a good job?*
2. *Can a right-angled turn on the same surface, as on a ceiling, be made without mitering the base, if the capping is properly mitered? Is it satisfactory?*

ELECTRICAL DEPARTMENT

INTERIOR WIRING

Installing wooden molding

References:

Croft, "American Electrician's Handbook," p. 457.

Sharp, "Practical Electric Wiring," p. 70.

Nelson, "Interior Electric Wiring and Estimating," p. 24.

Directions:

1. Determine positions of outlets and point of tapping main line circuit. Run molding between outlets. The base can be nailed to a wooden surface but over plaster long, thin, flat-head screws must be used. Support base every $1\frac{1}{2}$ to 3 feet on tile walls; if toggle bolts are used, they must extend through the capping. The molding can be shellaced before installing.

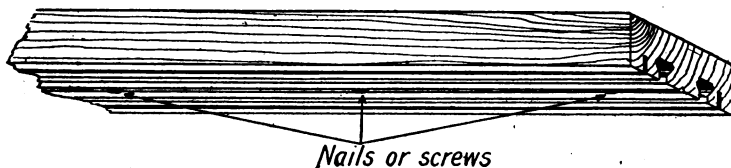
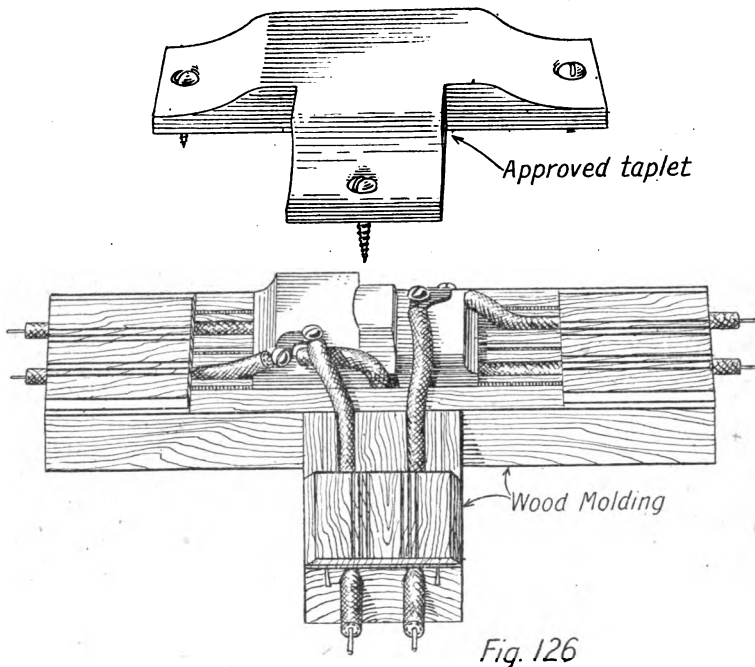


Fig. 125

2. Make all outlets, cross-overs, etc., with approved tap-lets. When molding reaches partitions, conductors must be passed through porcelain tubes. When conductors are carried through floors, they must be enclosed in standard rigid conduit.

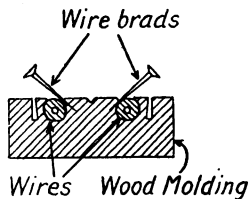
Molding must not be installed in damp places, elevator shafts, etc. On damp walls, such as outside brick walls, back-ings strips must be placed under molding.



3. Install single-braid, rubber insulated copper wire in molding of proper size to carry current capacity of circuit.

To hold conductors in position in molding running inverted, as on a ceiling, drive small brads at an angle into tongue between conductors and bend over wire.

Some molding is made to grip wire while running in conductors by being notched in the grooves, and no brads are needed.



4. Fit capping over molding, after brads are removed. Select capping best suited to trim on room. Fasten capping to base with screws or nails, which should be long enough to pass through the base, whenever possible.

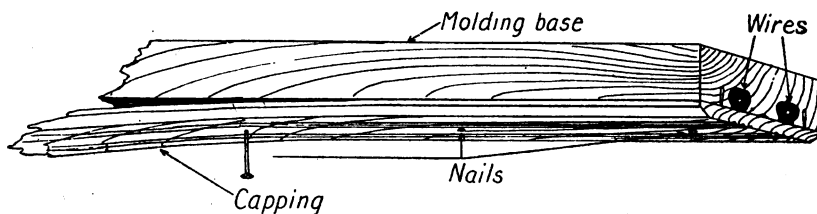


Fig. 128

Questions:

1. *How can conductors be brought through floors with kick blocks?*
2. *What is the danger of damp molding even with rubber-covered wire?*
3. *What is meant by "dead molding"?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING
Installing running boards and guard strips

References:

Croft, "American Electrician's Handbook," p. 443.

Croft, "Wiring for Light and Power," p. 260.

Cook, "Interior Wiring," p. 240.

Nelson, "Interior Electric Wiring and Estimating," p. 12.

Directions:

1. Inspect running boards or guard strips for size and straightness.

Running boards should not be less than 3 inches wide and $\frac{1}{2}$ inch thick.

Guard strips should not be less than $\frac{3}{4}$ inch thick and at least as high as the insulators used in the line to be guarded.

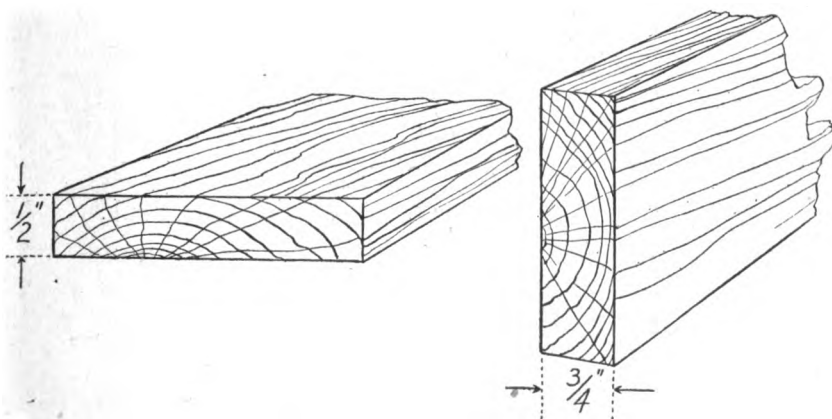


Fig. 129

2. Run each conductor on separate running boards, when wired on knobs. Nail boards on joists parallel with each other, keeping running boards separated from each other about two inches.

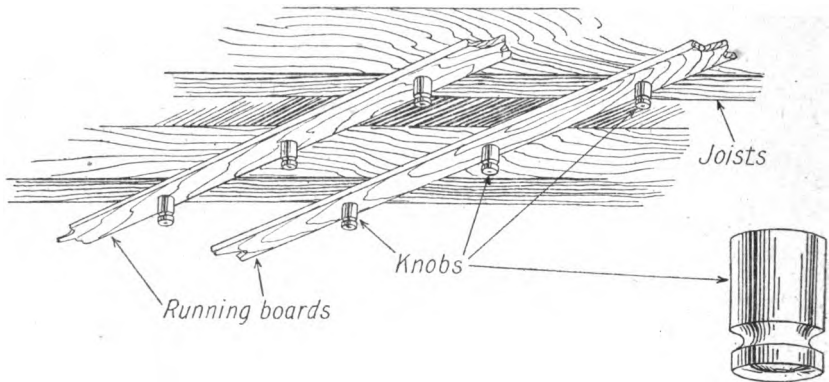


Fig. 130

3. Run each conductor in a separate groove of the cleat when cleats are used. Install cleats on running boards with nails or screws.

If run between joists is excessive, as in steel buildings, use carriage bolts to bolt a second running board on edge in center of back of regular running board.

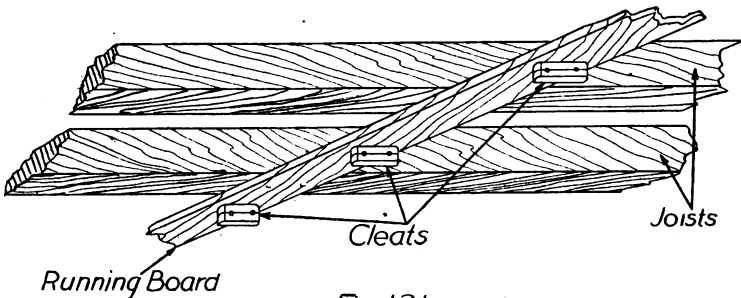


Fig. 131

4. Install guard strips parallel to conductors and close to them, when installed on knobs.

If distance between joists is excessive, install cross-cleats of wood between guard strips for supporting knobs.

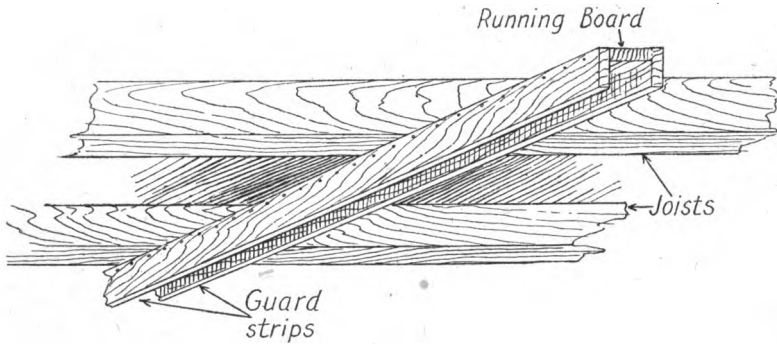


Fig.132

Questions:

1. *What is the purpose of using running boards?*
2. *Under what conditions are running boards necessary to open wiring?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing knobs

References:

Croft, "Wiring for Light and Power," p. 167.

Cook, "Interior Wiring," p. 236.

Nelson, "Interior Electric Wiring and Estimating," p. 2.

Directions:

1. Examine knobs carefully for checks, rough projections, or sharp edges which can injure the insulation of the conductors to be attached to the knobs.

Use split-knobs for conductors smaller than No. 8. For larger wires solid knobs can be used.

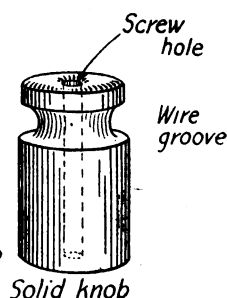
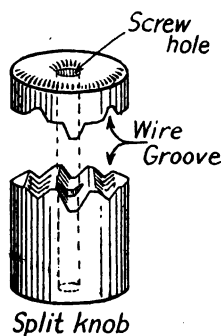


Fig. 133

2. Fasten knobs to surface with nails whenever possible. Place under head of nail a leather washer not less than $\frac{1}{8}$ inch in thickness, drive nail into position, bringing up snug without striking insulator beneath the washer.

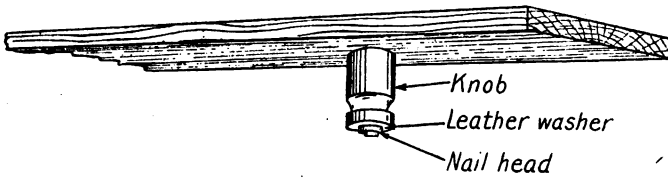


Fig. 134

3. Fasten knobs to surface with wood screws or bolts when underlying surface is not deep enough to permit a nail penetrating to a depth of one-half the height of the knob. Use special bolts on stone or tile walls.

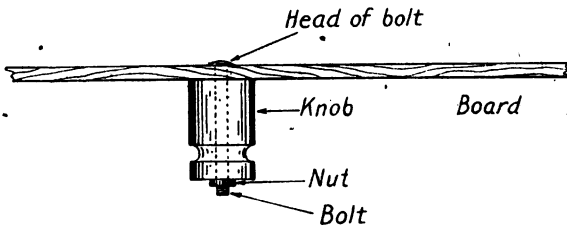


Fig. 135

4. Whenever possible run circuits on knobs on separate joists or on separate running boards.

When the conductor is very heavy and cannot be tied successfully to one knob, install a double row of knobs, in pairs, clamping the conductor between them in the groove.

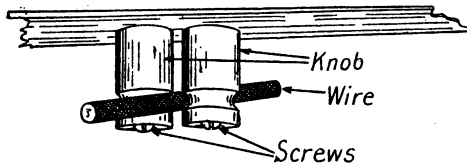


Fig. 136

Questions:

1. Why are split-knobs required for small conductors?
2. Why are nails preferable to screws for fastening knobs?
3. When are knobs preferable to cleats?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing cleats in open wiring

References:

Cook, "Interior Wiring," p. 236.

Nelson, "Interior Electric Wiring and Estimating," p. 12.

Croft, "American Electrician's Handbook," p. 446.

Directions:

1. Examine cleats carefully for checks, rough projections, or sharp edges which can injure the insulation of the conductors to be fastened under the cleats.

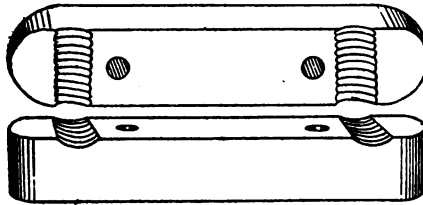


Fig. 137

2. Fasten cleats to surface with nails, whenever possible. Place under head of nail a leather washer not less than $\frac{1}{8}$ inch in thickness, and drive nail into position, bringing up snug without striking insulator beneath the washer.

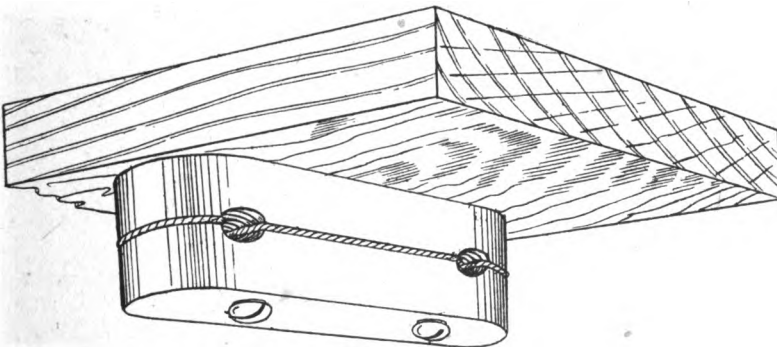


Fig. 138

3. Fasten cleats to surface with wood screws or bolts when underlying surface is not deep enough to permit a nail penetrating to a depth equal to the height of the cleat. Use bolts of special construction on stone or tile walls.

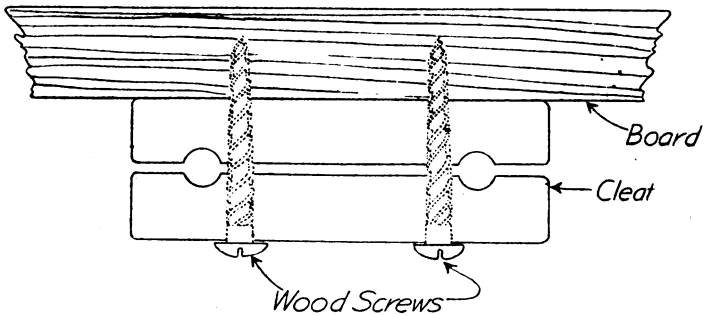
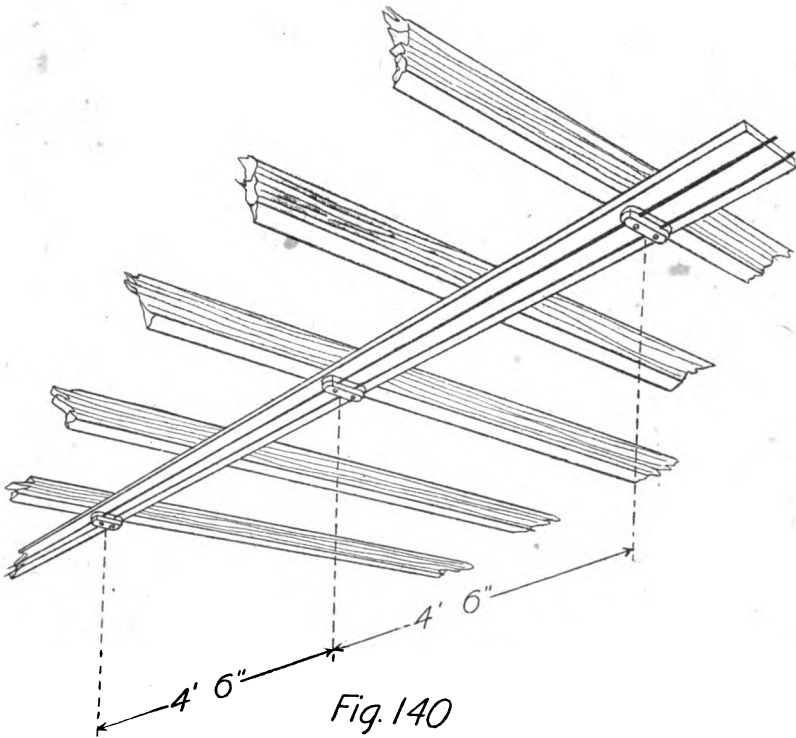


Fig 139

4. Run wires smaller than No. 8 in double and three-wire cleats. Larger wires should be run in single-wire cleats. Space cleats not less than $4\frac{1}{2}$ feet for ordinary conditions, and closer for heavier runs or when conductors are liable to be disturbed. Twin or duplex wire must never be used in cleat wiring.



Questions:

1. *What is the objection to the use of duplex conductors in cleats?*
2. *Why are nails preferable to screws? When are screws better?*
3. *What is the minimum spacing allowed between conductors in open wiring?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing Tubes

References:

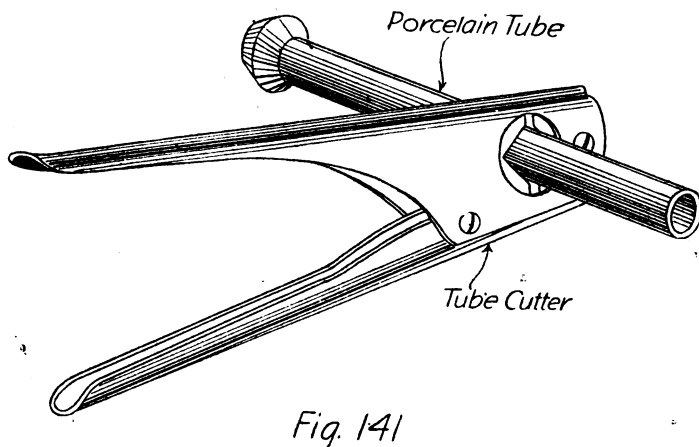
Croft, "American Electrician's Handbook," pp. 444, 445 and 473.

Sharp, "Practical Electric Wiring," p. 87.

Directions:

1. Inspect tubes for cracks or other defects in manufacture.

Use tubes of correct length for partition through which conductor will pass. If tube is too long, cut it to length by using a tube cutter or filing or grinding, a groove around tube and breaking it at groove.



2. Install porcelain tubes when conductors pass through walls, partitions, or floors. The tube must be long enough to pass through the entire length of hole, or else two tubes must be used, or the hole bushed with a pipe into which porcelain tubes are inserted. The conductor must not touch the iron pipe.

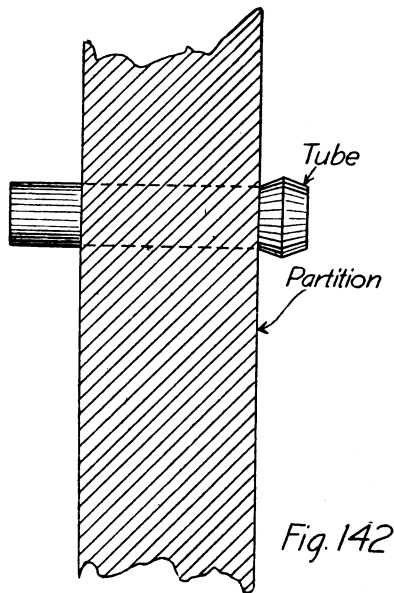


Fig. 142

3. Install porcelain tubes when conductors pass over other conductors. In every case, the inner conductor or the conductor nearest the surface carrying the conductor, must carry the tube.

Install tubes when conductors pass metal work or pipes to which they might be grounded. The tube should be taped at ends to prevent movement along conductor after installation.

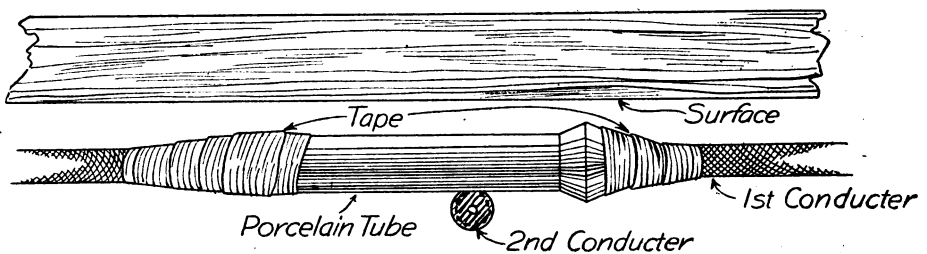
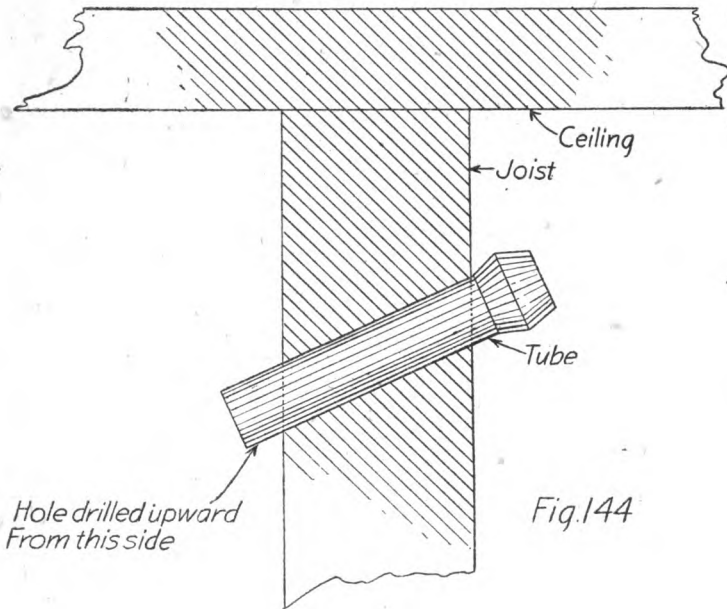


Fig. 143

4. Install tubes in holes bored in joists when conductors are carried through joists, keeping spacing between lines not less than five inches. Holes should be bored at a slight angle, and the tubes inserted with heads upward.

Install special floor tubes when conductors pass through floors, and install kick-blocks or guards to prevent injury to conductors and insulators.



Questions:

1. Why are porcelain tubes preferable to flexible loom when conductors pass through partitions?
2. Why is it desirable to drill holes at a slight angle in joists? What is the disadvantage of too great an angle when the conductor is threaded through?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Making a turn in open wiring

References:

Sharp, "Practical Electric Wiring," p. 64.

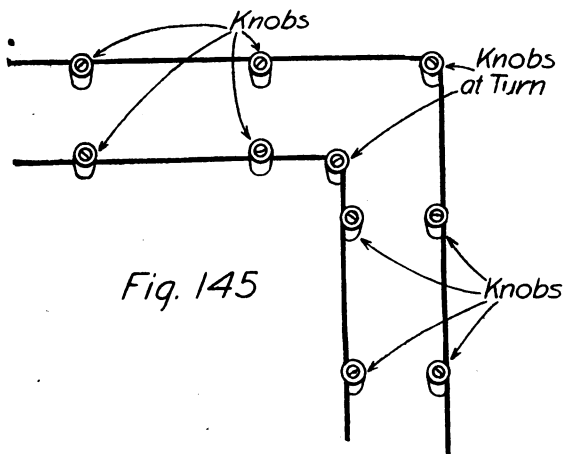
Croft, "American Electrician's Handbook," p. 446.

Directions:

1. Turning on knobs on the same surface:

Place knobs in straight line and at an angle of 45 degrees in a right-angled turn. Space knobs to bring spacing between conductors the same on both sides of turn.

Attach all conductors to knobs in approved manner.



2. Turning on knobs from one surface to another:

Place the last pair of knobs on the first surface and the first pair of knobs on the second surface about three inches from the corner formed by the two surfaces.

Attach all conductors to knobs in approved manner, and bend conductors at right angles, keeping them clear of underlying surfaces.

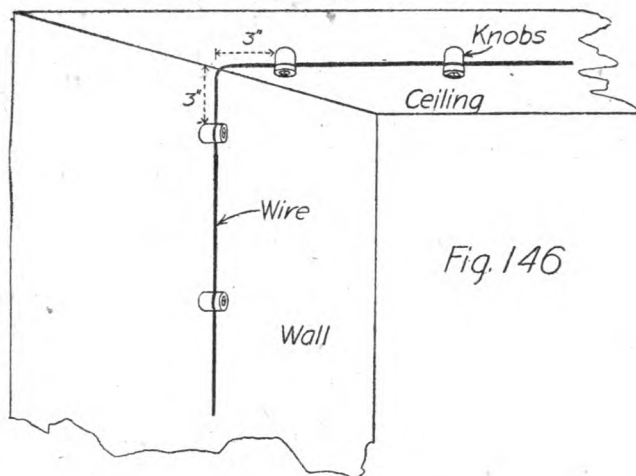


Fig. 146

3. Turning on cleats on the same surface:

Place the cleats at right-angles to each other, with **their** near ends separated about one inch.

Fasten conductors under cleats. Bend inside conductor **at** right-angles, and run outside conductor around bend in **grad-**ual curve from cleat to cleat.

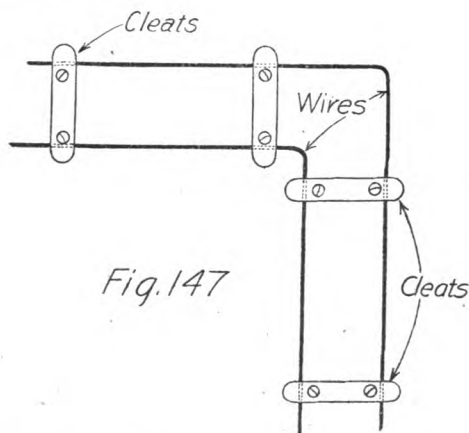
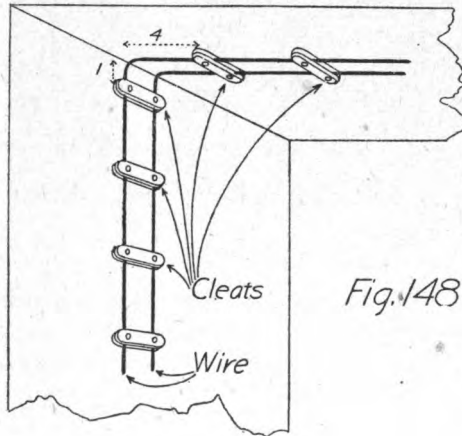


Fig. 147

4. Turning on cleats from one surface to another:

Place the last cleat on the first surface about one inch from the second surface, and the first cleat on the **second** surface about four inches from the first.

Fasten conductors under cleats, and bend them at right-angles between cleats, keeping them not less than $\frac{1}{2}$ inch from underlying surfaces.



Questions:

1. *Why is it necessary to support conductors firmly at bends?*
2. *Why is it not advisable to make a turn with one pair of cleats placed diagonally, as is done with knobs?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Making a "dead end" in open wiring

References:

Croft, "American Electrician's Handbook," pp. 442, 446.

Cook, "Interior Wiring," p. 242.

Sharp, "Practical Electric Wiring," p. 62.

Directions:

1. For knob wiring, install a standard knob of ending circuit. Bring end of conductor up to knob, after drawing up tight from other insulators in circuit, and make half-turn with conductor, twisting it around straight conductor.

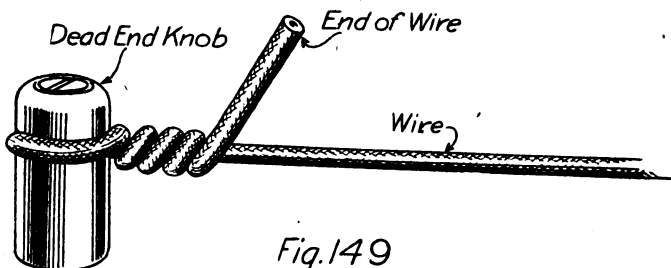


Fig. 149

2. Make five or six complete turns with conductor around itself, bringing it up securely with a pair of pliers.

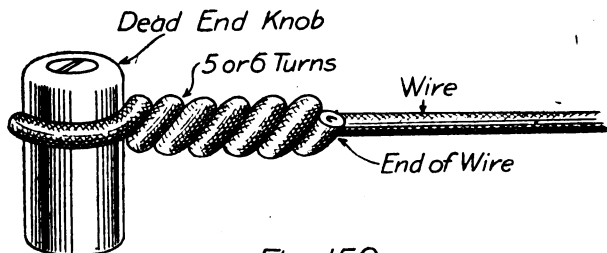
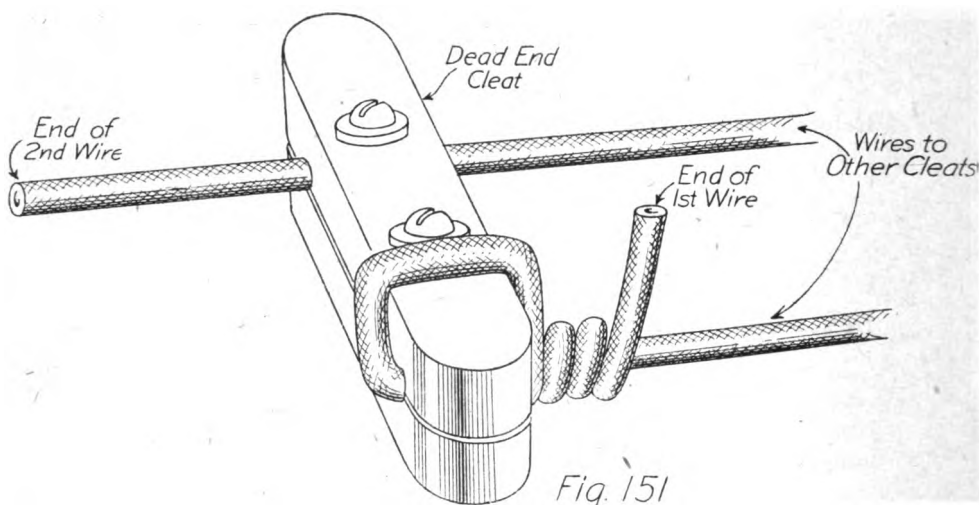


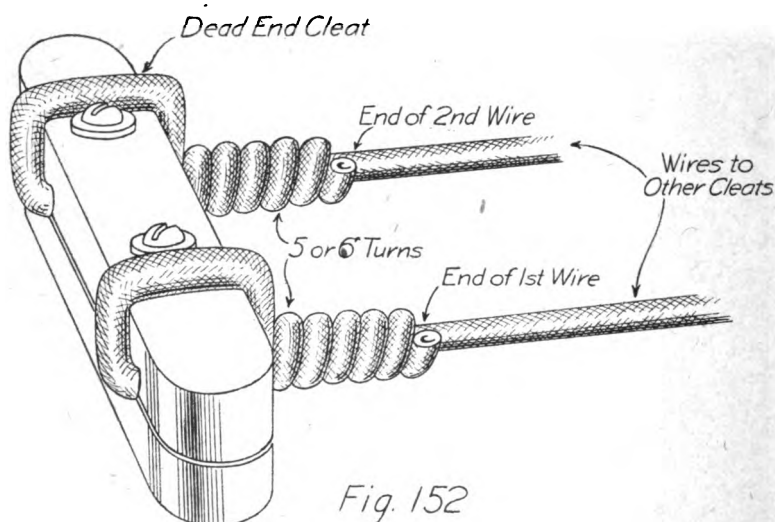
Fig. 150

3. For cleat wiring, install a pair of cleats at point of ending circuit. Bring conductors up to cleat, after drawing them up tight from other insulators in circuit, and make half-turn

around top half of cleat, twisting conductor around straight conductor.



4. Make five or six complete turns with conductor around itself, bringing it up securely with a pair of pliers.



Questions:

1. Why must special care be taken in "dead ending" an open circuit?
2. Is it satisfactory to "dead end" a circuit in a rosette or receptacle?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Tapping a circuit in open wiring

References:

Sharp, "Practical Electric Wiring," p. 62.

Cook, "Interior Wiring," p. 241.

Directions:

1. Determine position of tapping the main circuit. Remove insulation from conductors, spacing the distance between conductors of tap circuit equal to spacing of conductors of main circuit.

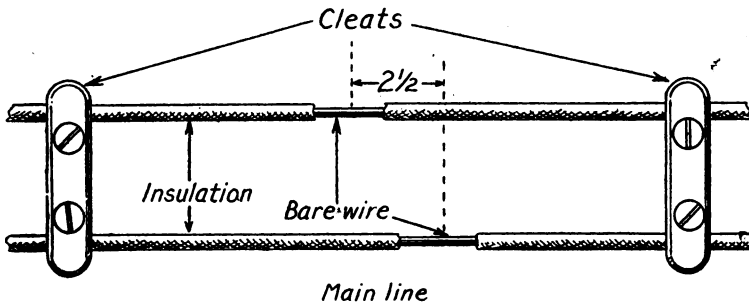


Fig. 153

2. Install cleats or knobs on each side of points of tapping main circuit to take strain from main conductors.

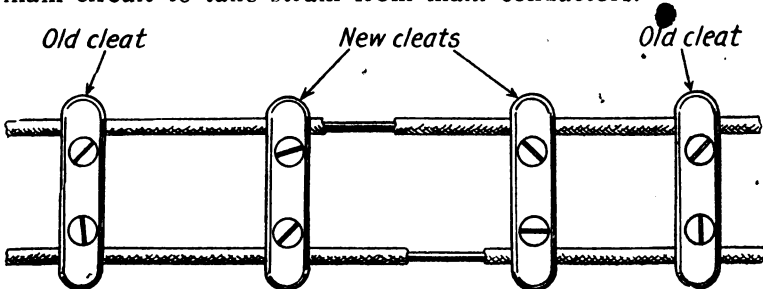


Fig. 154

3. Install a tube over the tap conductor which is to be soldered to main conductor. This tube should be long enough to reach from soldered joint to a point beyond the other main conductor. Slip the tube between the main conductor that is crossed and the surface over which the conductors run. Do not place the tube outside of the main conductor.

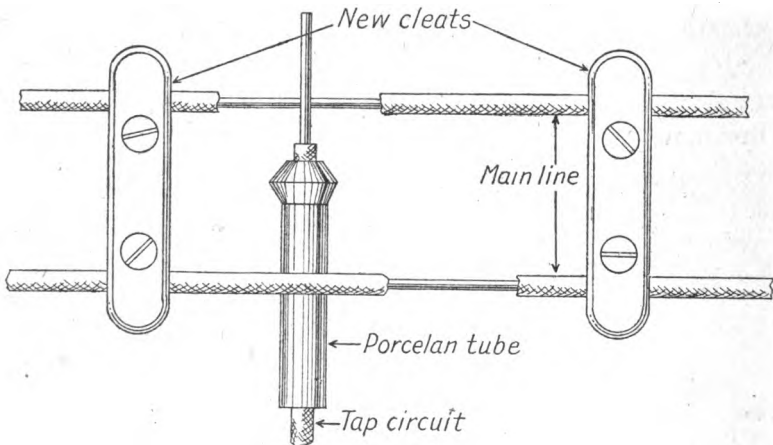


Fig. 155

4. Install a cleat or knobs on the tap circuit close to the end of the tube to prevent the tube from sliding away, and also to support the tap circuit and take strain from soldered joints.

Solder and tape joints carefully, and avoid scorching wall or ceiling if a blow-torch is used.

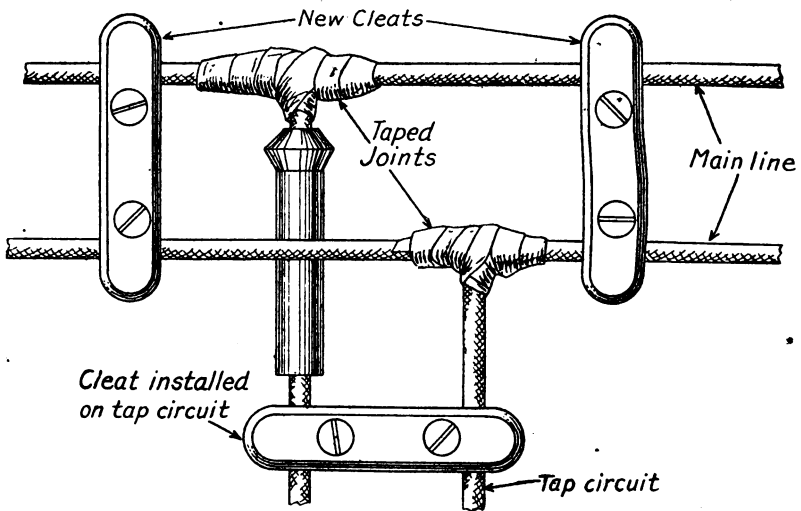


Fig. 156

Questions:

1. *Why is it objectionable to place the tube outside of main conductor instead of between main conductor and underlying surface?*
2. *What strains are liable to affect the joint between the tap circuit and the main circuit?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing loom

References:

Croft, "American Electrician's Handbook," p. 414.

Nelson, "Interior Electric Wiring and Estimating," p. 25.

Directions:

1. Install flexible tubing, or loom, from outlet to outlet when conductors are fished between partitions. Insert only one conductor in the tube.

It is not satisfactory to install short lengths of tube over the ends of the conductors, since the Code requires tubing over the entire length of a fished conductor.

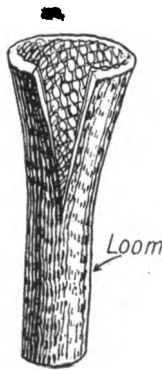


Fig. 157

2. Install short lengths of tube over ends of conductors when conductors are brought out of partitions for switches or fixtures. The tubing must extend to and touch the last cleat or knob supporting the conductor within the partition.

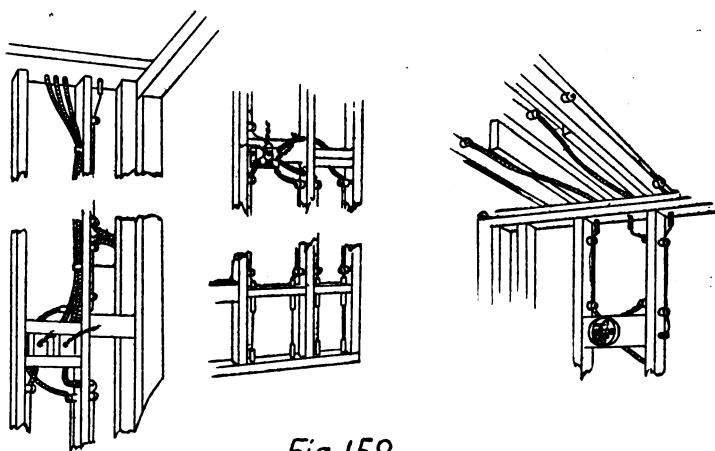


Fig. 158

3. Install loom over conductors passing other conductors, instead of porcelain tubes, if such are not available or not easily applied. In such cases, as with tubes, the conductors surrounded with loom must pass between the wall or ceiling and the conductors to be passed. The conductor surrounded with loom must not pass under the other conductors. Use loom when passing pipes, beams, etc.

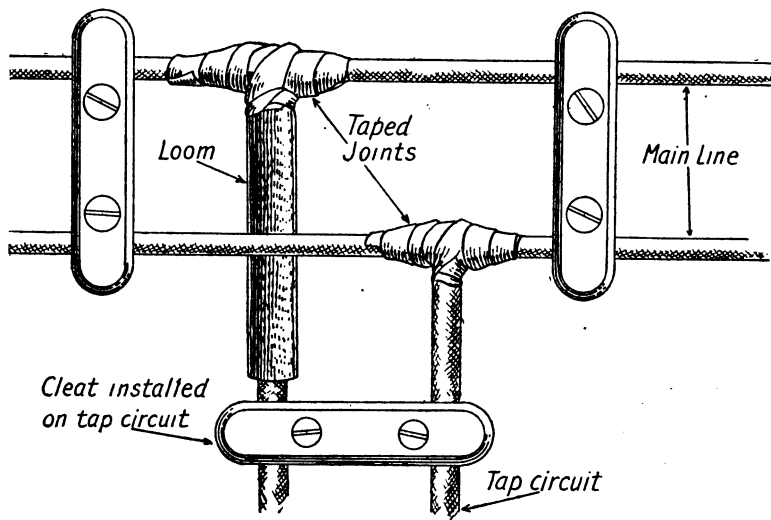


Fig. 159

4. Install loom over conductors, in open or concealed work, even when supported on insulators, if the distance between conductors cannot be maintained as required by the Code or local wiring rules.

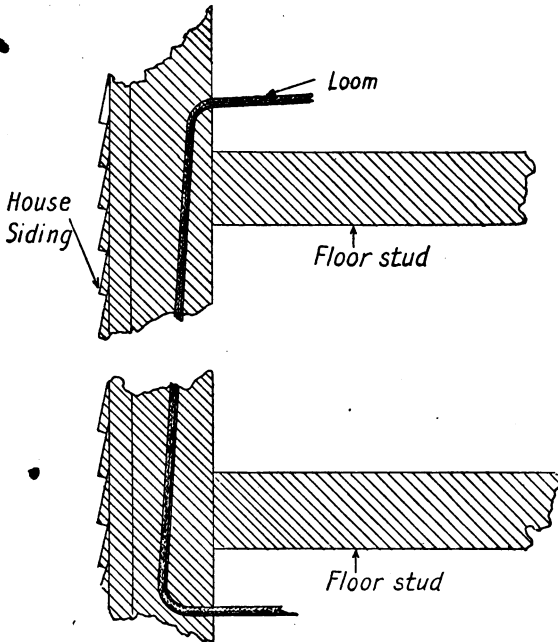


Fig.160

Questions:

1. Why is it not desirable to place two conductors within a piece of loom?
2. Can loom be used in damp locations? Why?
3. How should loom be cut?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Stringing conductors on knobs and cleats

References:

Croft, "American Electrician's Handbook," p. 422.

Nelson, "Interior Electric Wiring and Estimating," p. 17.

Directions:

Lay out conductors along floor, under the running boards to which they will be installed.

Fasten conductors at one end of run under a pair of cleats.

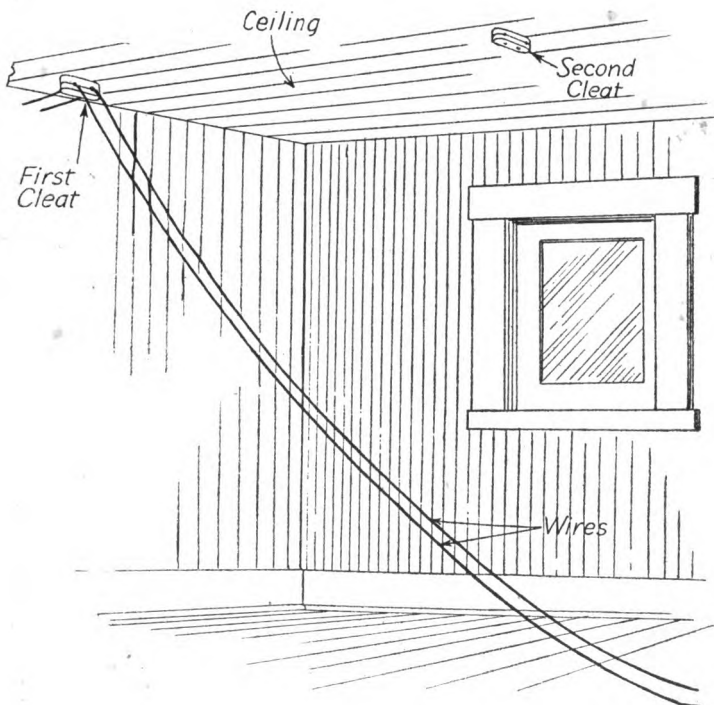


Fig 161

Install a second pair of cleats at or near the opposite end of run, and pull conductors in line through the cleats, fastening the cleats securely.

With the conductors held in line, install all intermediate cleats using a spacing of $4\frac{1}{2}$ to 5 feet between cleats. Do not screw cleats down tight.

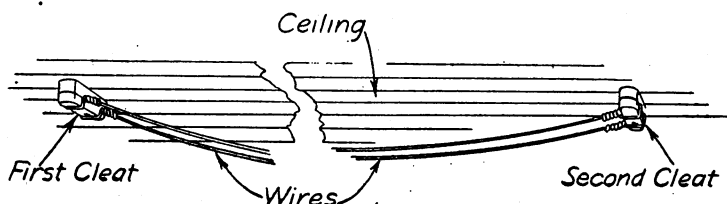


Fig. 162

Pull up conductors as tight as possible, using a stick or hammer handle around which conductors can be wrapped for pulling.

With conductors pulled up tight, fasten down all cleats tightly, taking care not to nail or screw them down tight enough to crack them.

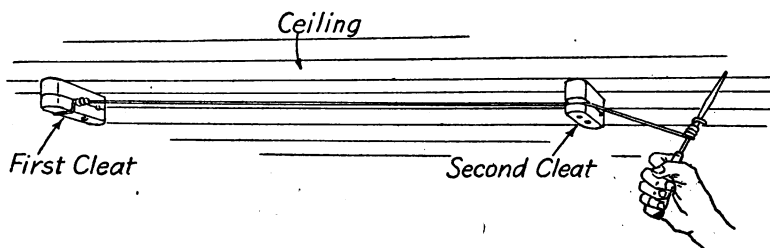


Fig. 163

Install conductors on knobs in same manner, if split knobs are used.

Attach conductors to solid knobs with tie wires of the same size and insulation as the main conductors. Twist tie wire around main conductor four or five times on each side of knob. Do not twist main conductor around knob.

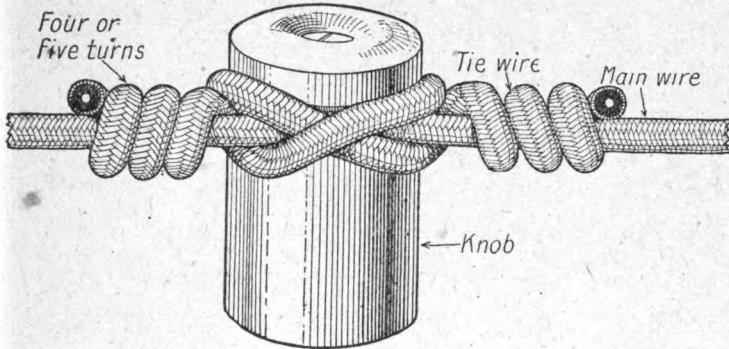


Fig. 164

Questions:

1. What is the purpose of installing two cleats at quite a distance from each other, and then filling in with cleats between them? Why not put up in successive order from the start?
2. Why is it necessary to use a tie wire of the same material as the main conductor?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Connecting knob and cleat wiring to boxes

References:

Nelson, "Interior Electric Wiring and Estimating," p. 13.

Croft, "American Electrician's Handbook," p. 473.

Croft, "Wiring for Light and Power," p. 257.

Directions:

1. Using federal bushing. Insert porcelain bushing in hole or knock-out of box, after removing the threaded sleeve into which the porcelain bushing is screwed.

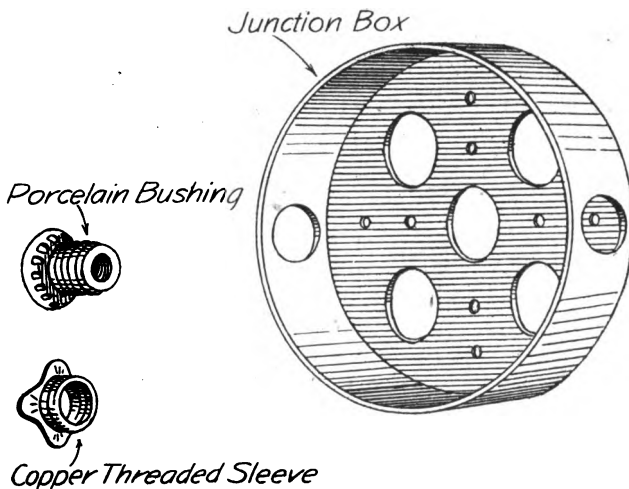


Fig. 165

2. Place the threaded sleeve of bushing on opposite side of hole in the box, and screw the bushing into the threaded sleeve until the bushing is screwed firmly against the side of the box.

Run conductors through bushings into the box, using one bushing for each conductor.

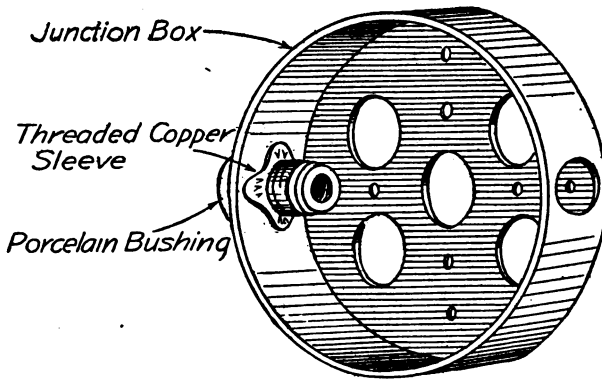


Fig. 166

3. Using porcelain tubes. Drill holes in side or end of wooden box to fit the porcelain tubes. Press tubes into holes with heads of tubes so placed as to prevent tubes from slipping out of holes in box.

Run conductors through the tubes into the box using one tube for each conductor.

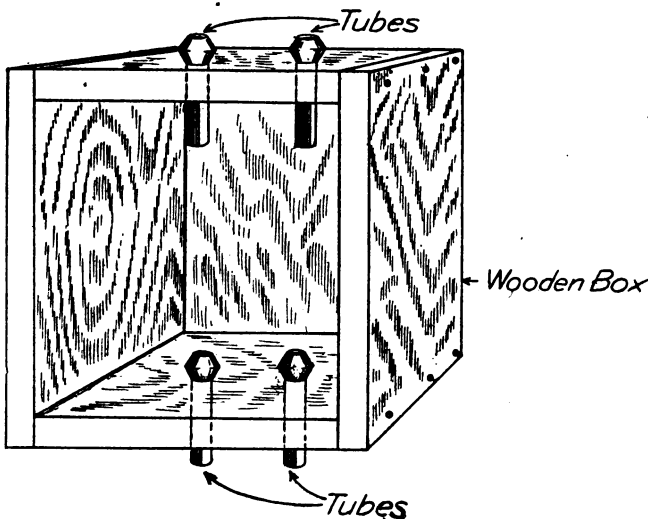


Fig. 167

4. Using loom. Slip a piece of loom over end of conductor. Pass conductor and loom through hole or knock-out in box,

so that loom will rest on inside edge of hole and extend beyond the box to protect the conductor from damage to insulation. If a short piece of loom is used, tape the loom to the conductor to prevent slipping.

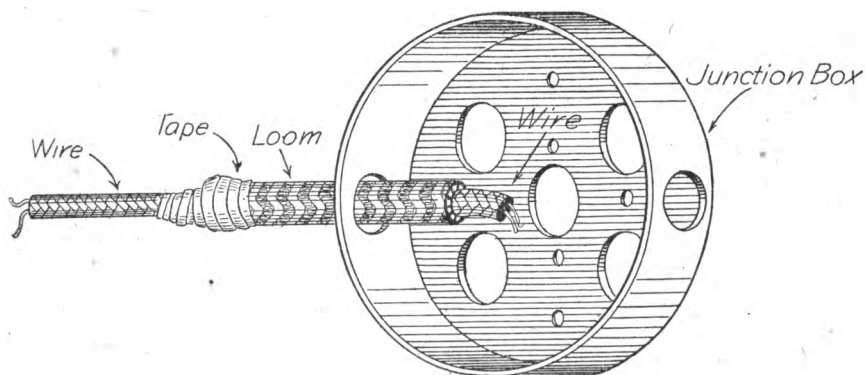


Fig. 168

Questions:

1. *Is it necessary to tape porcelain tubes to the conductors?*
2. *Can Federal bushings be used with wooden boxes?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing switch box in unfinished wall

References:

Nelson, "Interior Electric Wiring and Estimating," p. 92.

Directions:

1. Using wood lath. Determine position of switch box in partition. If lath is available, nail two strips of lath across the studding at the height of the box, and spaced apart so that the ears of the box can be screwed to the lath.

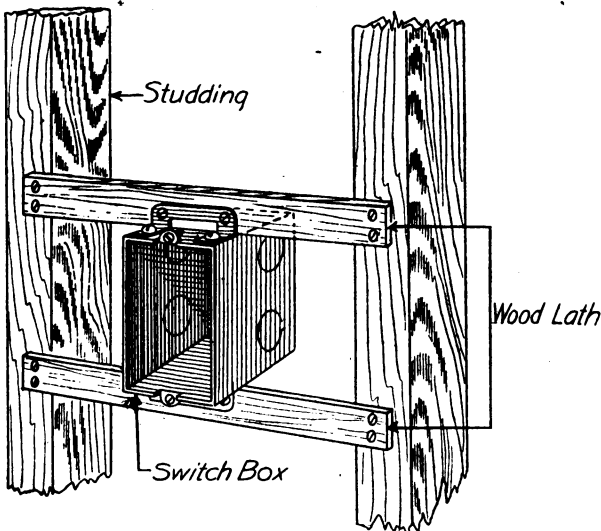


Fig. 169

2. Using wood block. Determine position of switch box in partition. Nail a wood strip across the studding at the height of the box and immediately back of it. Fasten the box to the block with wood screws.

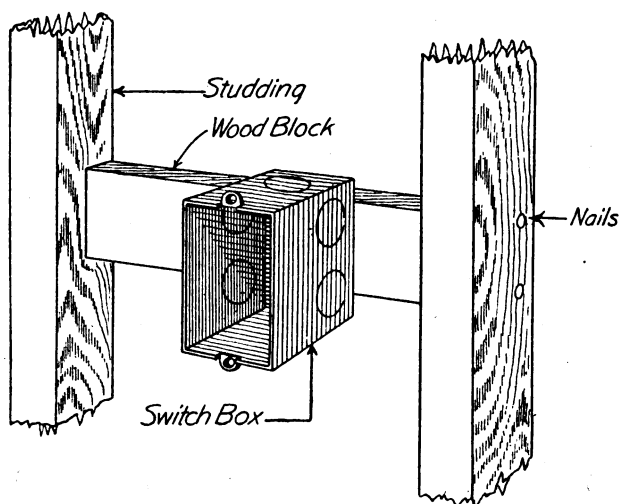


Fig. 170

3. Using metal box cleat. Determine position of switch box in partition. Nail cleat to studding at the height of box. Screw box to cleat, using machine screws and nuts furnished with the cleat.

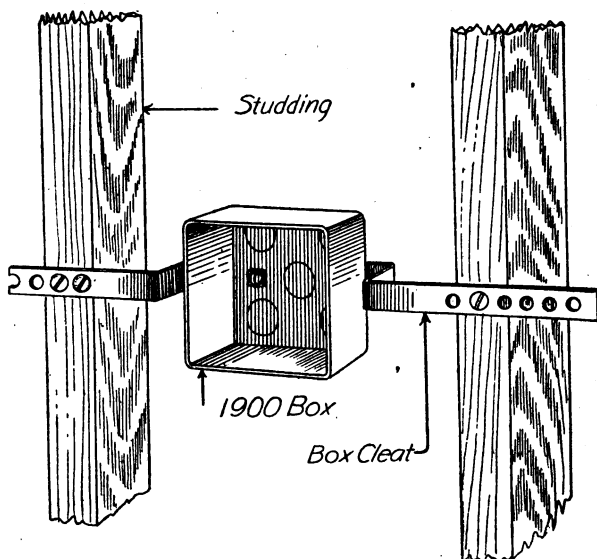


Fig. 171

4. Using combination switch covers. Determine position of switch box in partition. Nail combination plate to one stud so that plate will extend to the point desired for the switch position. Screw switch box to back of plate.

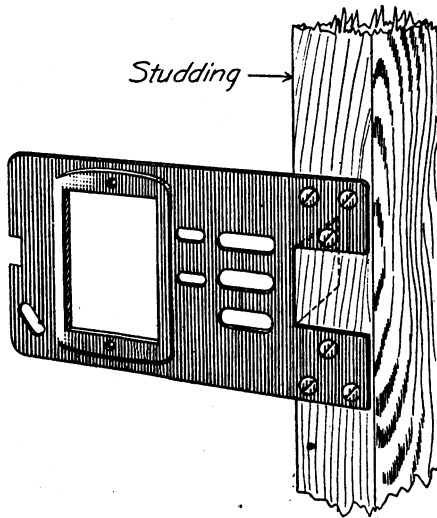


Fig.172

Questions:

1. How is box mounted on wood lath brought to level of plaster?
2. How is box mounted on wood block brought to level of plaster?
3. Can box hangers be mounted incorrectly?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing switch box in unfinished fireproof wall

References:

Nelson, "Interior Electric Wiring and Estimating," p. 123.

Cook, "Interior Wiring," p. 229.

Directions:

1. Install conduit from ceiling outlet to position of tile or fireproof wall to be built later, leaving a threaded drop in the approximate location of the new wall.

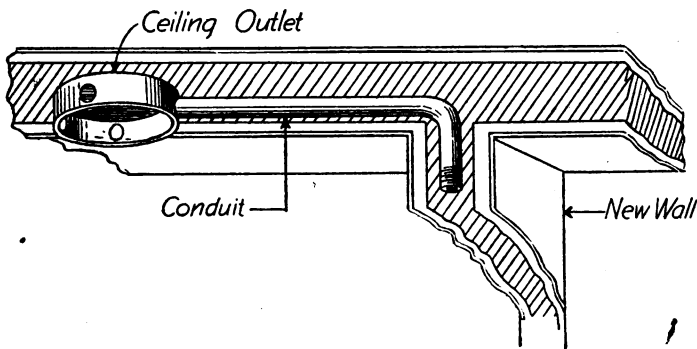


Fig. 173

2. Extend the conduit from the drop down to the position of the switch box just before the tile is laid for the wall.

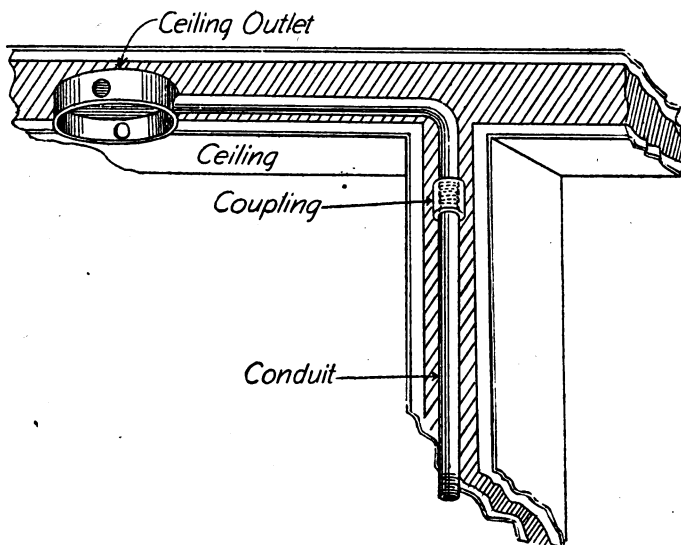


Fig. 174

3. Attach standard box with cover to conduit and make necessary connections to other conduit runs ending in box, if such are needed. Plug entrance of conduit with cork stoppers or blank plates and bushings, if conductors are not pulled into conduit immediately.

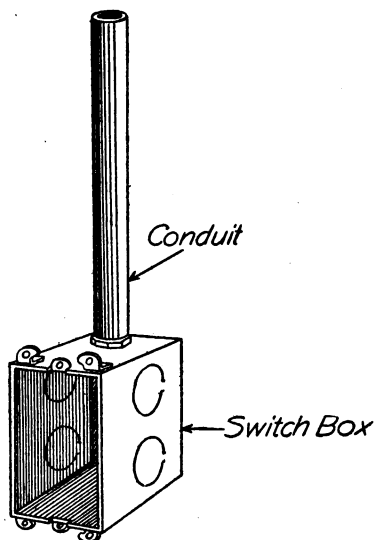
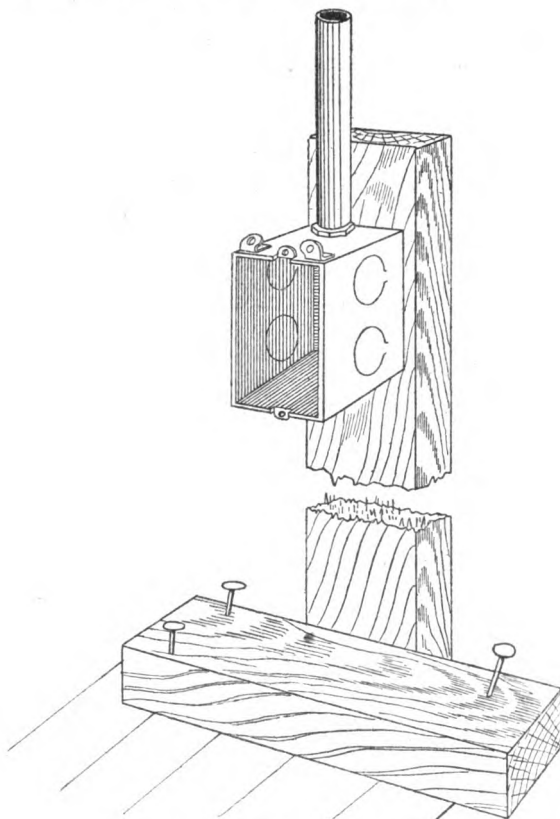


Fig. 175

4. Support box temporarily with false work, if necessary, until tile is built around the box and conduit.

If an additional box is wanted in tile wall which is finished but not plastered, flexible armored conductor can sometimes be fished through the tile, and the box installed in tile by making opening for it by the usual methods.



Box On Temporary Rigging

Fig. 176

Questions:

1. How is the alignment of the box determined before the tile is placed?
2. Would the above method be changed if concrete walls were installed?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing switch box in wood lath and plaster

References:

Nelson, "Interior Electric Wiring and Estimating," p. 75.

Croft, "Wiring of Finished Buildings," p. 247.

Cook, "Interior Wiring," p. 227.

Directions:

1. Mark two lines on wall, using back of box as guide, in vertical direction only. With small sharp chisel or knife, break into plaster between lines, carefully, to find one lath.

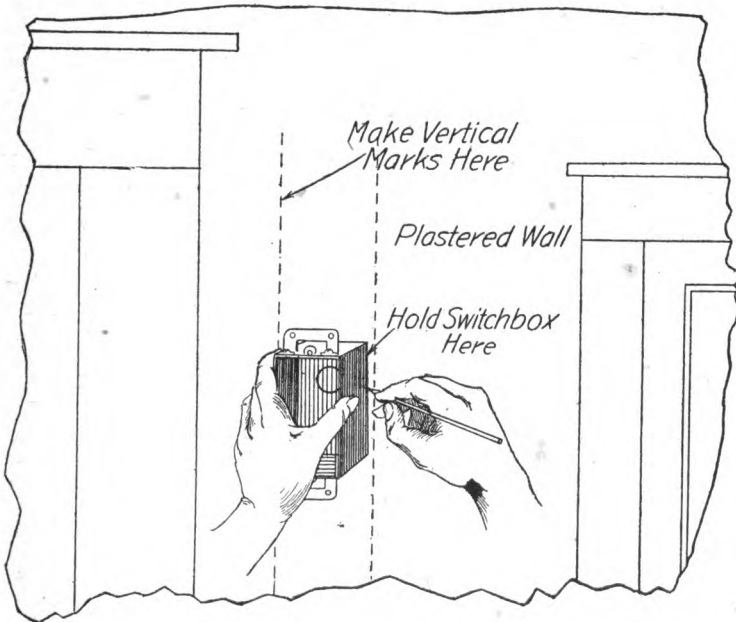


Fig. 177

2. Uncover carefully, one lath and opening on each side of lath. The center of this lath will be the center of the box. With this point as center of box, place box over opening,

and draw two horizontal lines at top and bottom of box. Break away plaster carefully to these lines and make a square opening in plaster for the box.

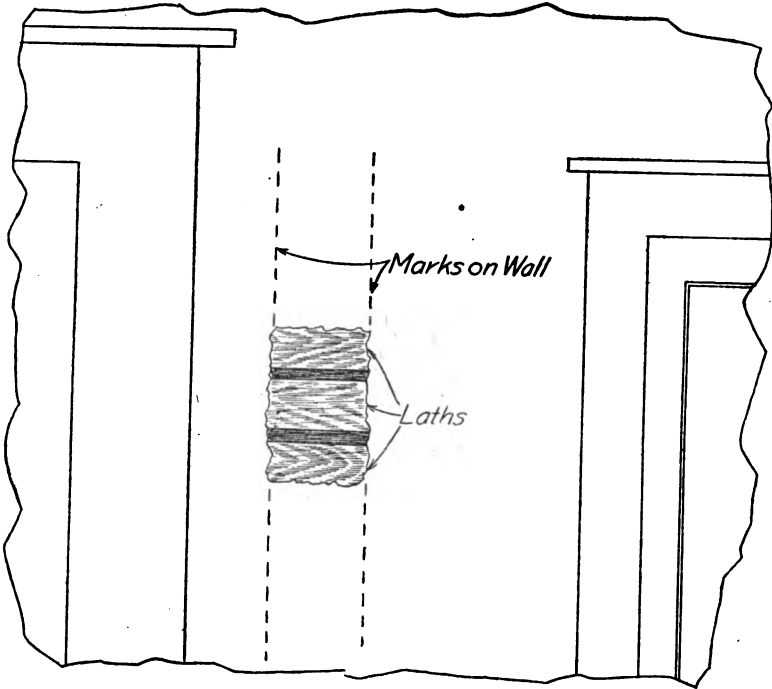


Fig. 178

3. Saw center lath at each edge of opening, sawing first at one edge and then at the other until center lath is removed. Saw carefully into top and bottom lath to depth of opening, and remove wood between saw cuts with a knife or chisel, making an opening in lath equal to size of box.

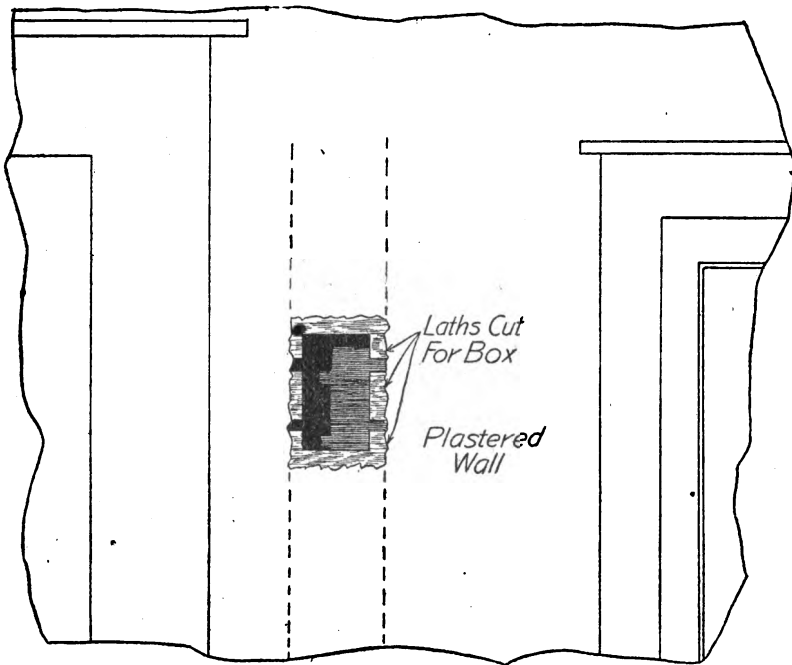


Fig.179

4. Slip box into opening, and chip away plaster at top and bottom of box to allow the box ears to rest on the lath. Screw the box ears to the lath with small wood screws, and adjust box for proper level with plaster.

Before installing box, have the necessary knock-outs removed.

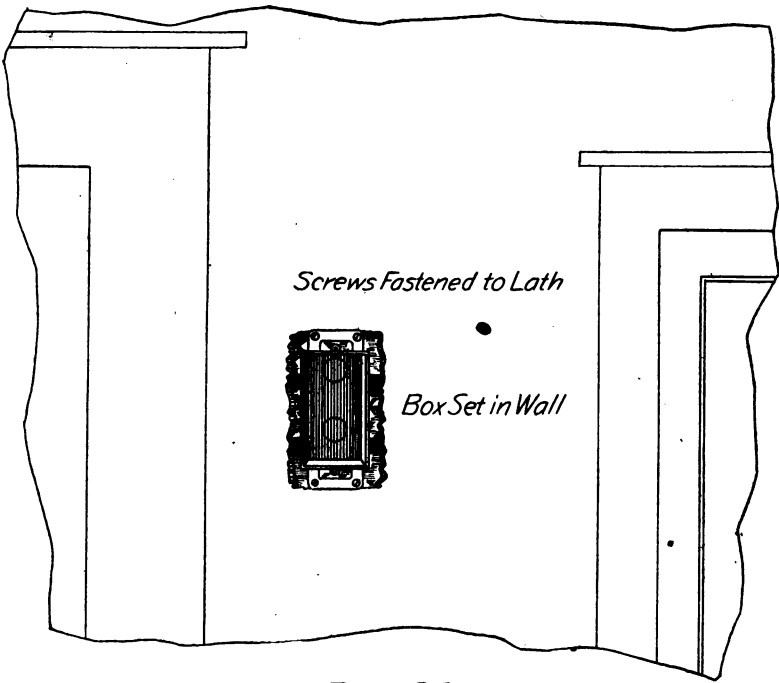


Fig. 180

Questions:

1. *Why is it advisable to remove center lath by cutting from edge to edge, instead of cutting or sawing entirely through one edge?*
2. *Why is it not possible to cut out the plaster for a box without finding the center lath?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing switch box in wire lath or wallboard

References:

Cook, "Interior Wiring," p. 215.

Directions:

1. Determine position of switch box and, using switch box as a guide, mark upon wall four lines showing the exact size and location of the box.

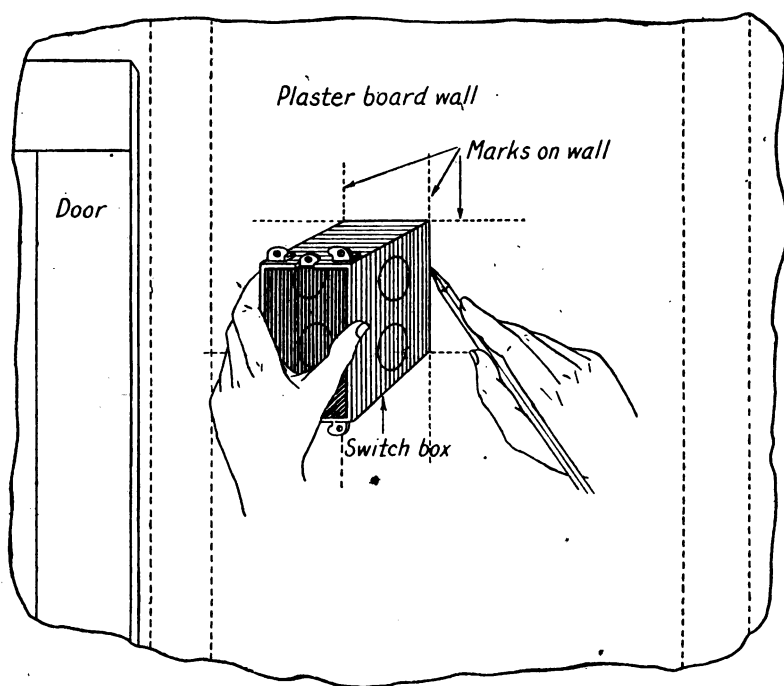


Fig. 181

2. Remove plaster or wallboard along the lines drawn with the box, using chisel, knife, or key-hole saw.

Remove the wire lath with a hack-saw blade, removed from a hack-saw frame.

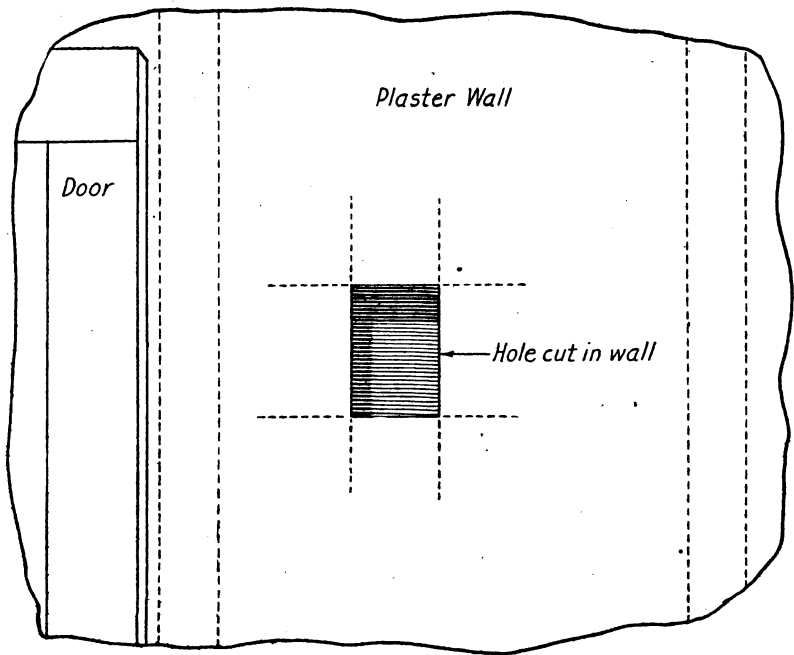


Fig 182

3. Prepare two strips of wood about one inch square and longer than the width of the box opening. Slip these strips behind the opening, one at the top and one at the bottom, holding them with small wood screws screwed through the wallboard or plaster into the strips, or small brads used in the same manner. The screws or brads must be so placed as not to be visible after the switch plate is installed, or wall paper applied.

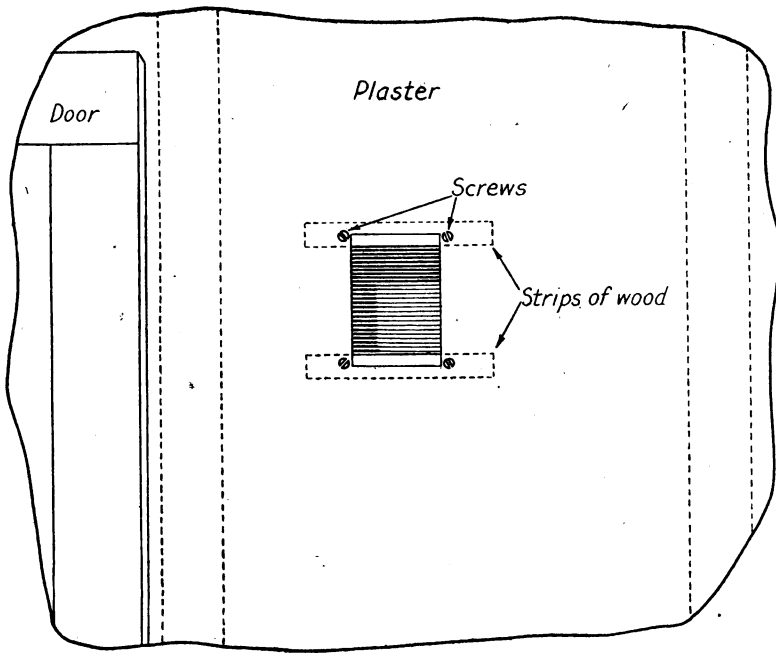


Fig. 183

4. Insert the switch box into the opening, screwing the ears of the box to the strips of wood.

In new work the box is sometimes placed in an opening in the wire lath and held in place by surrounding it with plaster or plaster of Paris.

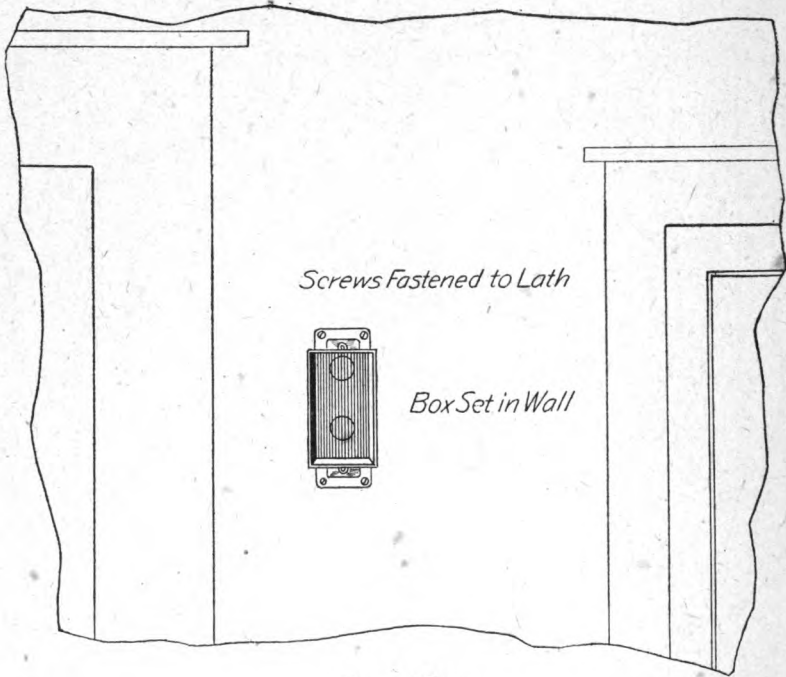


Fig. 184

Questions:

1. How are the ears of the box adjusted to bring the box flush with the wall?
2. Could the box be fastened to the wall without wood strips?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing switch box in tile and plaster

References:

Sengstock, "Electrician's Wiring Manual," p. 29.

Nelson, "Interior Electric Wiring and Estimating," p. 33.

Directions:

1. Determine position of switch box in wall, and using box as guide, mark position of opening on the plaster. Cut away plaster and tile along the lines indicated, using a wide, sharp cold chisel.

Exercise great care in chipping the tile, since it has a tendency to break off in large pieces.

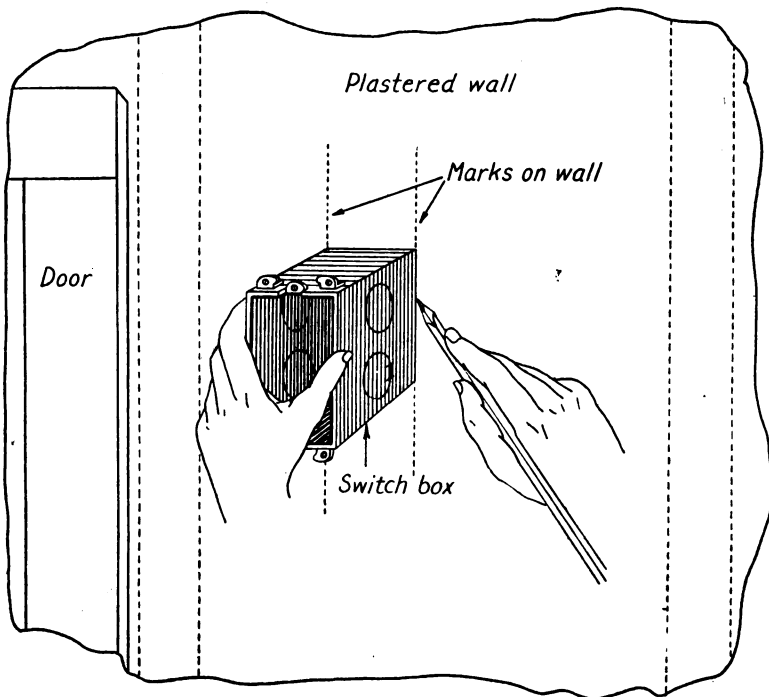


Fig. 185

2. Knock-out a hole in proper end of switch box for entrance of conductors. Insert a chase nipple into knock-out, with hexagonal head on inside of box.

Clamp ovalduct to the chase nipple with a standard ovalduct conduit adapter.

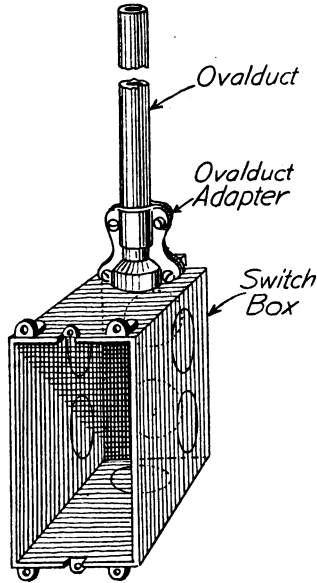


Fig. 186

3. Slip box with conduit attached into opening cut for it. If necessary, chip away enough tile at top or bottom of opening to receive the adapter.

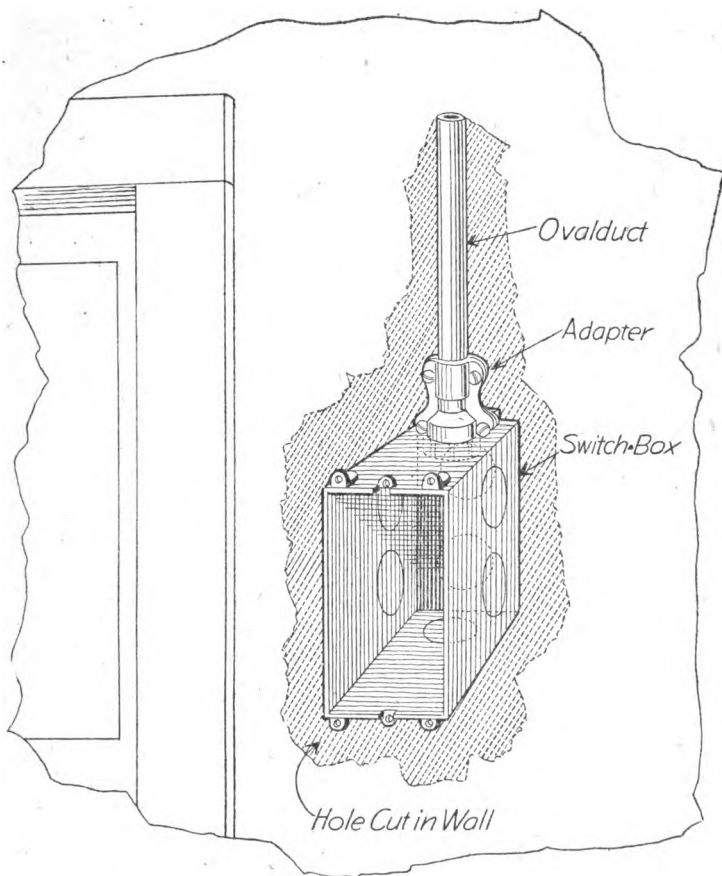


Fig. 187

4. Wedge the box in the opening in the tile with pieces of broken tile or wood, or by using plaster of Paris. The box must be flush with the wall, and in alignment.

Install box in same manner in tile, if rigid or flexible conduit or conductor is used in place of ovalduct, except for method of attaching to box.

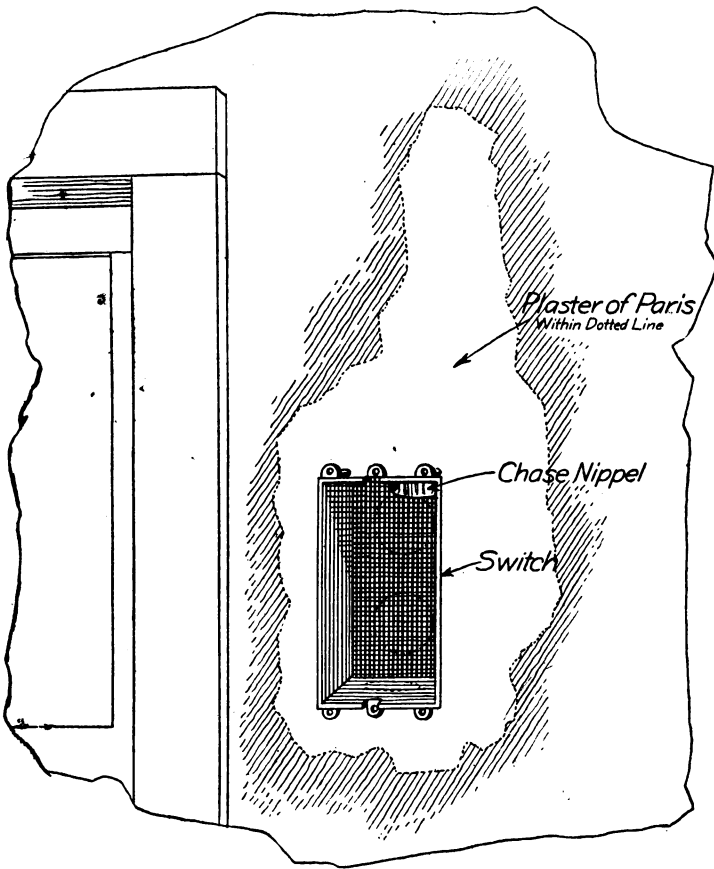


Fig. 188

Questions:

1. How far should the first edge of the box extend beyond the tile to bring the switch flush with the plaster of the wall?
2. How is the damaged surface of the plastered wall around the edge repaired?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing switch box in baseboard

References:

Croft, "Wiring of Finished Buildings," p. 207.

Croft, "Wiring for Light and Power," p. 245.

Directions:

1. Determine position of switch box in baseboard. Avoid as far as possible, such difficult drops as would be met in brick or concrete walls, and place the box, if possible, in a place to which a circuit may readily be fished.

Mark the outline of box on baseboard, using the box as a guide, and drill a hole in two diagonal corners to receive a key-hole saw.

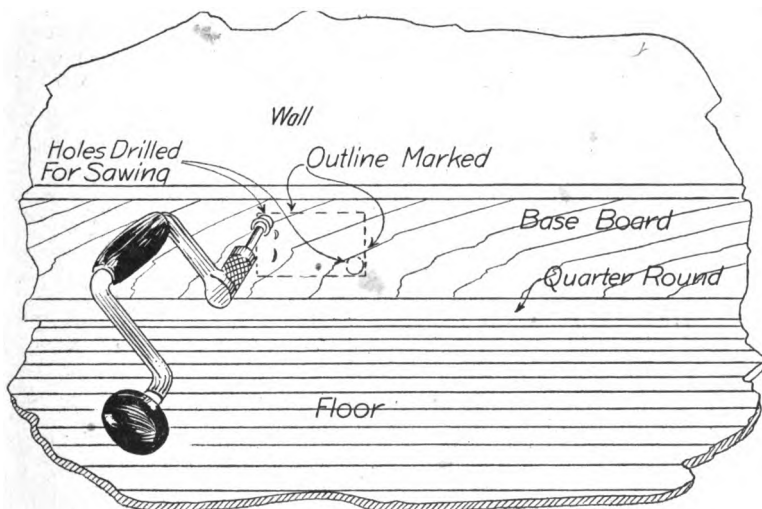


Fig. 189

2. With the key-hole saw saw carefully along lines marked, sawing in two directions only from each hole.

Remove the wood block cut out with the saw. If necessary, cut the wall behind the opening to a sufficient depth to receive the box.

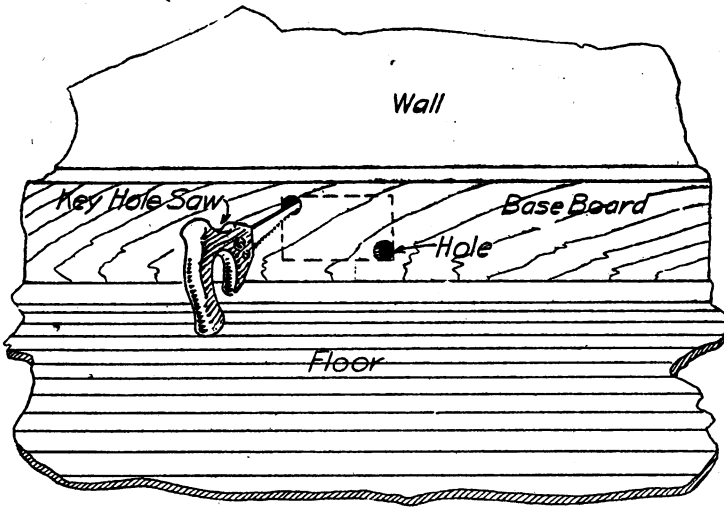


Fig. 190

3. Bring the box flush with the surface of the baseboard by chiseling at the ends of the opening a recess in the baseboards to receive the box ears.

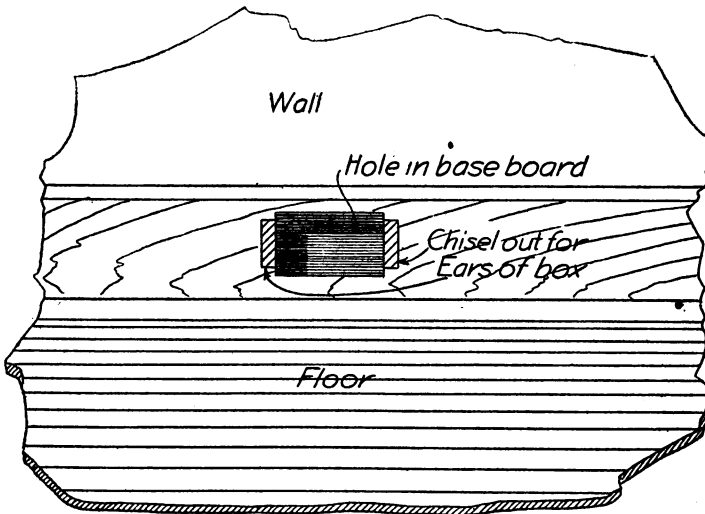


Fig. 191

4. Install box in opening, after suitable knock-outs have been removed, using small, flat-head wood screws.

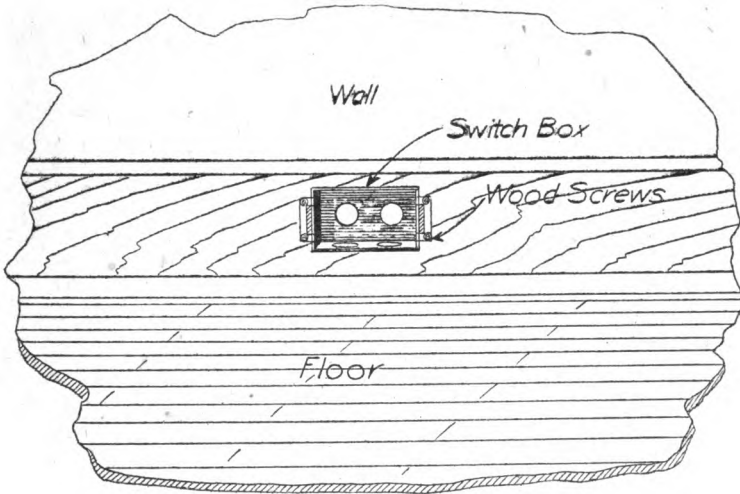


Fig. 192

Questions:

1. *How could a circuit be fished to a baseboard box, if a drop could not be made?*
2. *What is the objection to installing a box in the floor and flush with floor?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing switch box for metal molding

References:

Directions:

1. Select the proper type and size of switch box. Remove cap from base of box. If conduit is connected with the molding through the box, make the necessary knock-outs in base of box before installing.

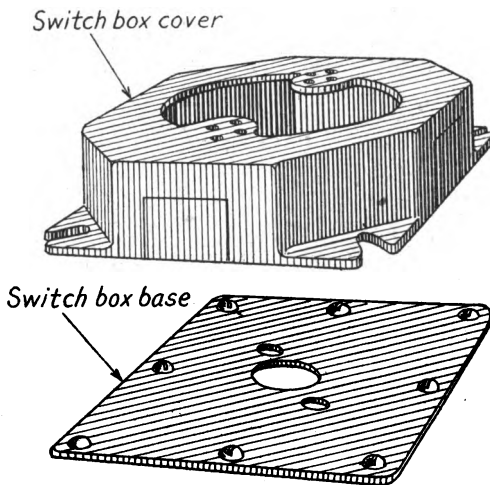


Fig. 193

2. Attach base of box to metal molding with standard metal molding bushing.

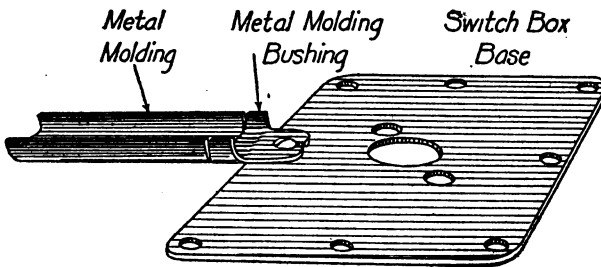


Fig 194

3. Attach base of box to underlying wall or surface with wood screws or toggle bolts, as the case may require.

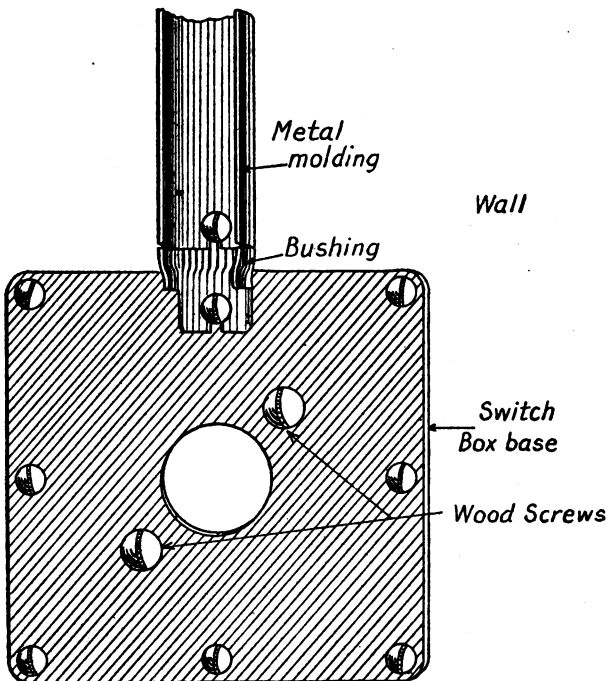


Fig.195

4. Replace cover or cap of box. If a switch or receptacle is to be attached to the box cap, install the switch or receptacle on the cap, replace them on the base and connect conductors.

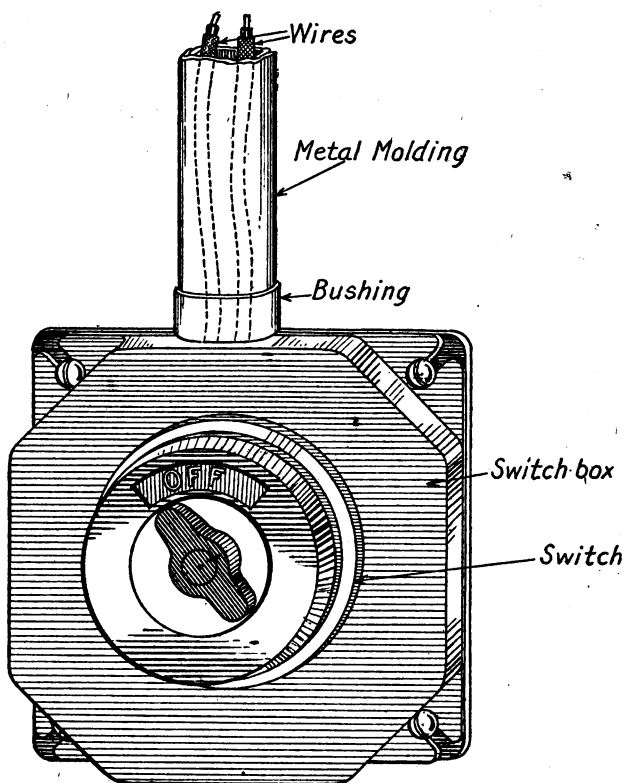


Fig. 196

Questions:

1. *Could this type of box be used for concealed work?*
2. *What kind of cover would be used with a metal molding switch box?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing exposed outlet box

References:

Cook, "Interior Wiring," p. 216.

Directions:

1. Select the proper type and size of box for the outlet desired, and remove suitable knock-outs for conduit connections.

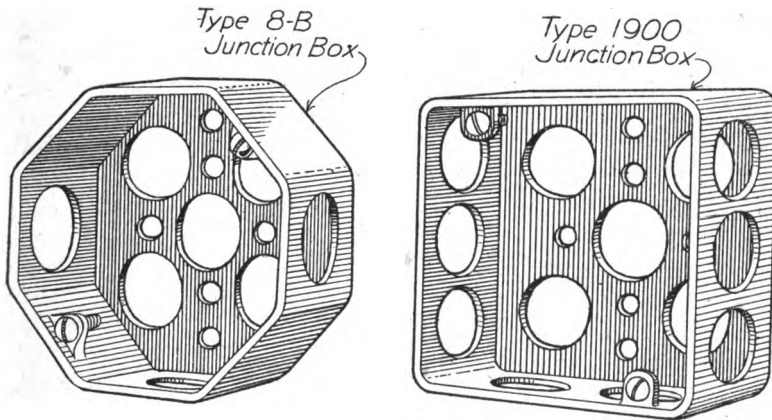


Fig. 197

2. Determine position of outlet box. If construction of building is such that no support is found directly under the box, nail a wooden strip, to wall to which box must be screwed.

If desired approved hangers can be used instead of the wooden strips.

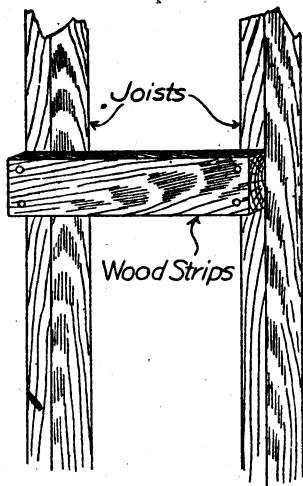


Fig. 198

3. Screw the box to the underlying surface, using wood screws, toggle bolts, expansion bolts, or other forms of bolts, depending upon the underlying surface.

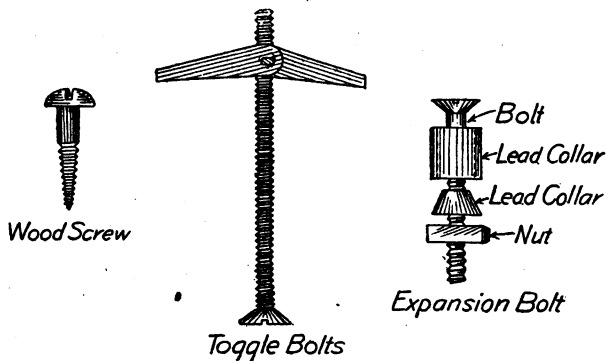


Fig. 199

4. Attach box to conduit in approved manner, and attach cover. If conductors are not pulled into conduit immediately, plug ends of conduit in box to prevent entrance of grit or other material.

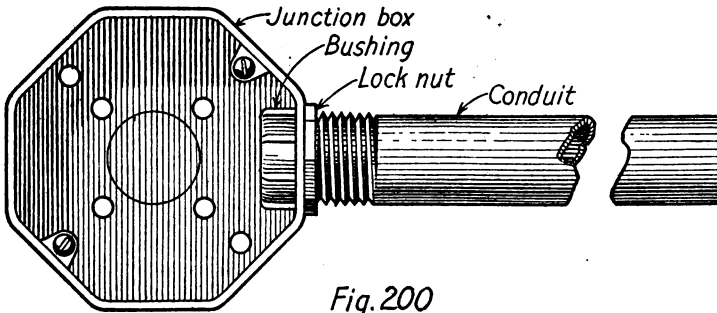


Fig. 200

Questions:

1. *How can an exposed switch outlet box be converted into any other form of outlet?*
2. *In what places are exposed outlets used?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing fixture outlet box at gas outlet

References:

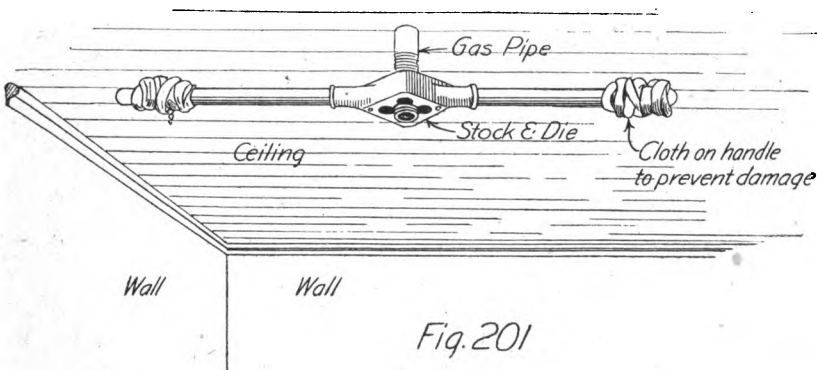
Nelson, "Interior Electric Wiring and Estimating," p. 68.

Croft, "Wiring for Light and Power," pp. 322, 325.

Directions:

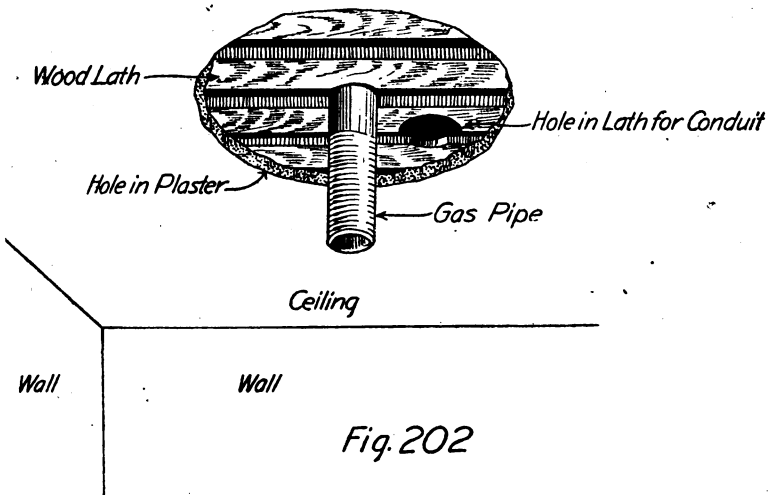
1. Remove gas fixture from gas pipe drop in ceiling or wall. If gas pipe extends too far from ceiling or wall for the electric fixture canopy, remove nipple from gas drop and replace with shorter nipple. If pipe is not removable, cut off pipe with a hack-saw, and rethread the gas pipe.

When threading pipe, be careful not to mar or damage ceiling or wall finish:



2. Remove plaster around gas pipe to receive the fixture outlet box, using a small chisel or a special plaster cutter. After lath is exposed, remove a small piece of lath or drill a hole through the lath for the flexible conductor entrance.

Fish the conductor through the opening, and if in a conduit, have box connector attached.



3. Attach a gas or bonding clamp to the inside of fixture outlet box, after removing necessary knock-outs for pipe and conduit, using small machine screws and nuts.

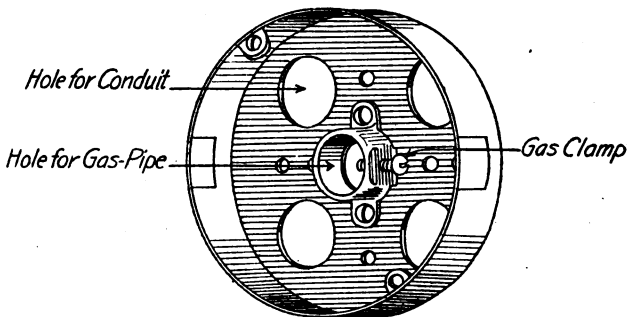
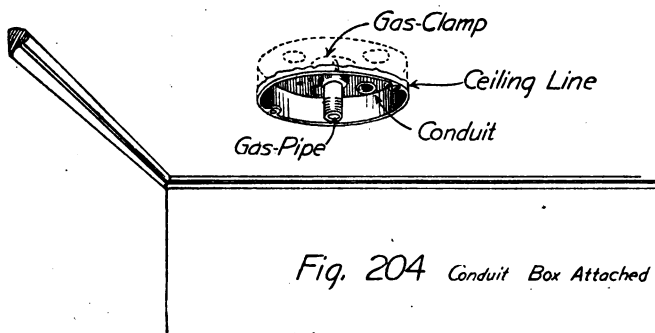


Fig. 203 Ceiling Box

4. Slip fixture outlet box over pipe, attaching conduit box connectors to box before installing it in final position. Slip box against lath, fastening to gas pipe with gas clamp and to laths with wood screws.



Questions:

1. When is it necessary to use the gas clamp with gas outlets?
2. How can a pipe stock be protected from damaging ceilings or walls when threading short gas drops?
3. What is done if the gas pipe is loose?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing fixture outlet box in unfinished frame building

References:

Nelson, "Interior Electric Wiring and Estimating," p. 93.

Cook, "Interior Wiring," p. 229.

Directions:

1. Determine carefully the position of the fixture outlet. Mark position on floor below and with a plumb bob carry the point back to joists above.

Remove necessary knock-outs from bottom of fixture outlet box, and install fixture stud in customary manner.

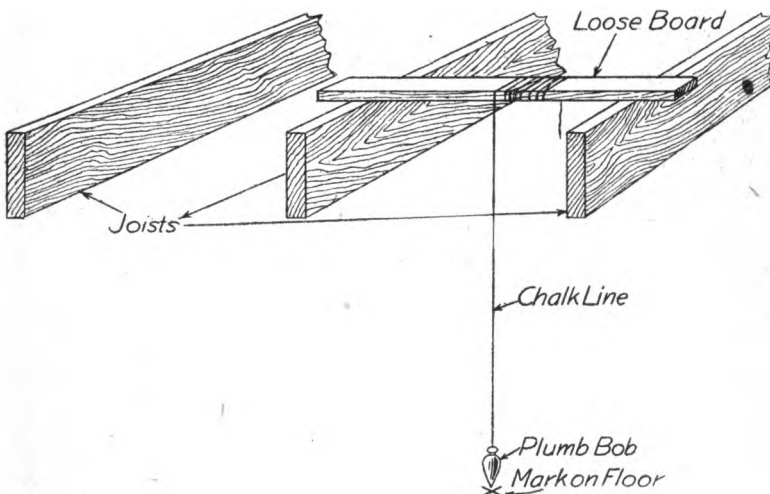


Fig.205

2. Nail a metal, adjustable box hanger to the under side of joists so that center of hanger will come in correct position for the outlet, and attach box to hanger.

If the box hanger has a fixture stud, none is required in the box, but the center knock-out must be removed, and the box attached to hanger with lock-nut on the hanger fixture stud.

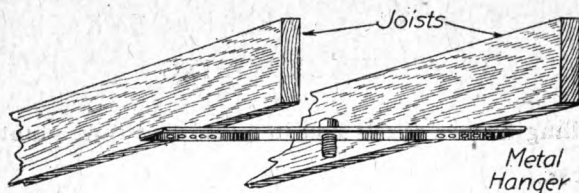


Fig.206

3. If no metal hanger is available, nail a wooden hanger between the joists. Drill the necessary holes in hanger for conduit entrance to box. Bring the hanger in such a position that the outlet box will hang at the correct level for the lath and plaster.

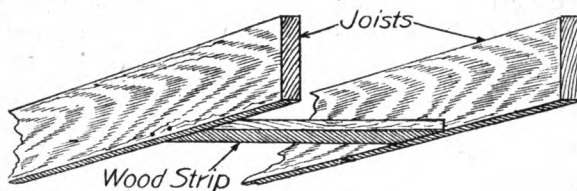


Fig.207

4. Attach conduit to box with approved fittings and pull in conductors.
Inspect installation for looseness.

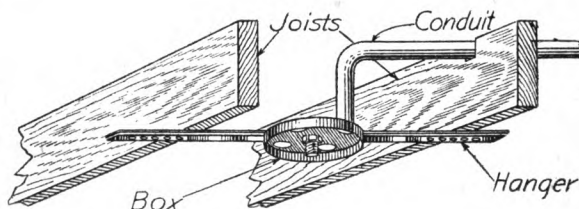


Fig.208

Questions:

1. Why should the wooden hanger not be placed in the same place as the metal hanger?
2. How should the conduit be run from the box across the joists?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing fixture outlet box in unfinished fireproof building

References:

Nelson, "Interior Electric Wiring and Estimating," p. 121.

Croft, "Wiring for Light and Power," p. 325.

Directions:

1. After forms and falsework have been removed from the floor, and just before the wooden sleepers are laid for the flooring, punch holes through the tile with cold chisel or long star drill for the conduit and T-hanger.

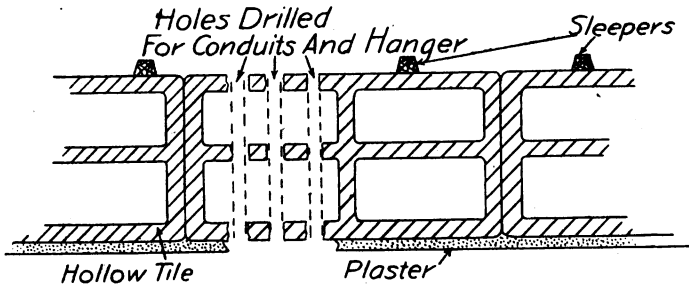


Fig.209

2. Bend conduit into shape to fit outlet and drop through holes made for it.

Drop T-hanger into place, using a short length of $\frac{1}{2}$ -inch pipe for the T.

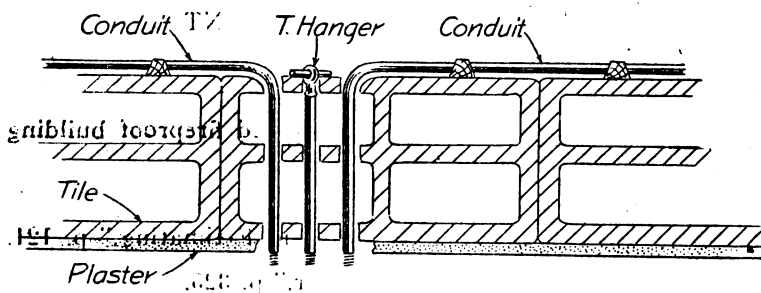


Fig. 210

3. Install a fixture outlet box, $\frac{3}{4}$ inch deep, clamping it to the tile with the lock-nuts, placing one nut on each side of box.

Attach conduit to box in approved manner.

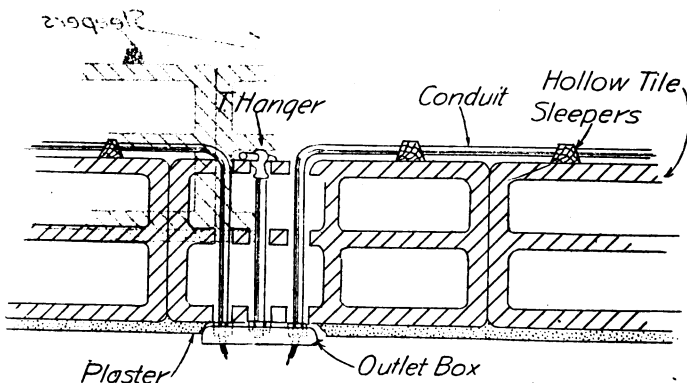


Fig. 211

4. Fill in opening in tile above the box with broken tile and concrete, making a solid tile above the fixture.

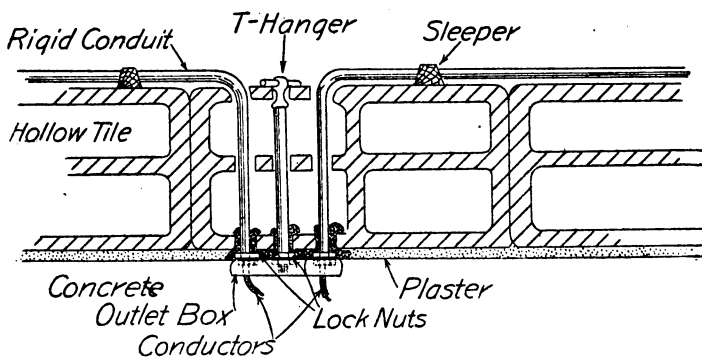


Fig. 212

Questions:

1. Why is it necessary to use a $\frac{3}{4}$ -inch box for the tile ceiling?
2. Why should the box be installed before the sleepers are installed on floor above?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing fixture outlet box in wood lath and plaster

References:

Croft, "Wiring of Finished Buildings," pp. 115, 107.

Nelson, "Interior Electric Wiring and Estimating," p. 93.

Directions:

1. Locate position of outlet. Remove plaster after marking a circle on the plaster, using the box as a guide, by cutting a circular hole in plaster with plaster cutter.

Drill or cut a hole in lath for conduit entrance, and also for hanger, if a box hanger is used.

Remove suitable knock-outs from box.

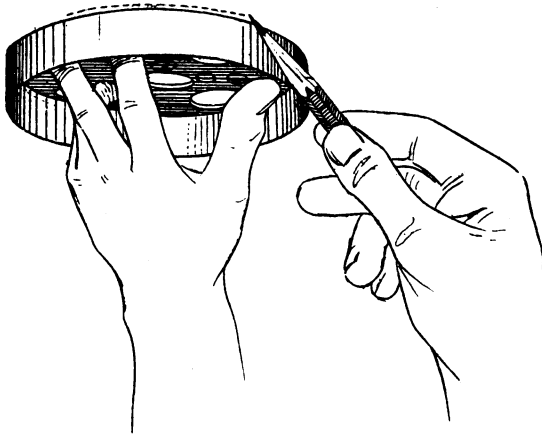


Fig. 213

2. If a fixture stud is used, fasten it to the center of the fixture outlet box with the nuts inside the box.

After attaching conduit to the box, fasten it to lath with wood screws or to wood blocks placed behind lath.

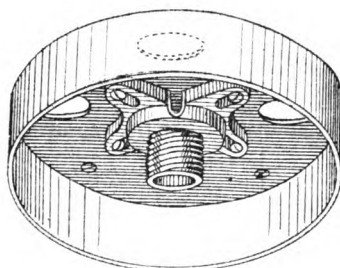


Fig. 214

3. If a box hanger is used, no fixture stud is used, but the center knock-out is removed from the box.

Slip the box hanger through the hole in lath, and bring the fixture stud of hanger through its hole in lath.

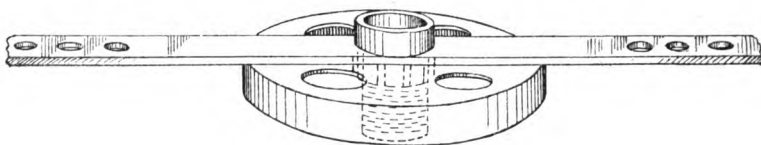


Fig. 215

4. Slip the fixture outlet box over stud of box hanger after the conduit has been connected to box. Fasten box to lath by screwing up lock-nut on fixture stud against inside of box.

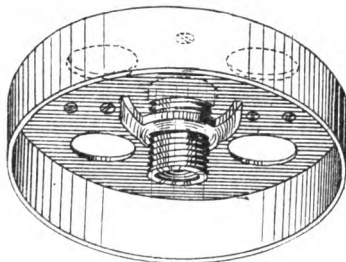


Fig. 216

Questions:

1. Why should the fixture stud nuts be placed on inside of box?
2. How deep should the box be for wood lath and plaster?

ELECTRICAL DEPARTMENT INTERIOR WIRING

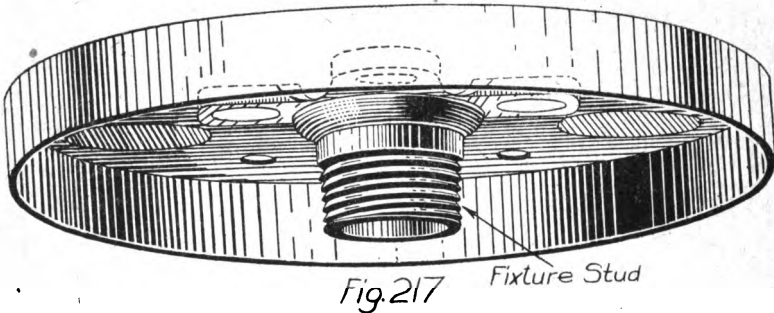
Installing fixture outlet box in wire lath or wallboard

References:

Directions:

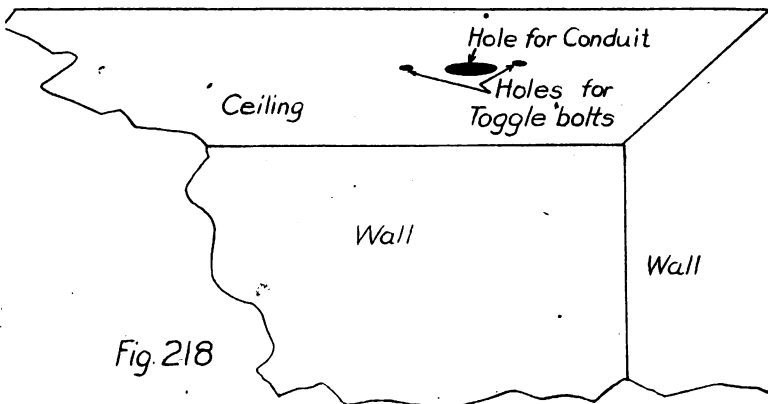
1. Locate position of fixture outlet and drill holes in plaster or wallboard for conduit outlet.

Remove the necessary knock-outs and insert the fixture stud in the box.

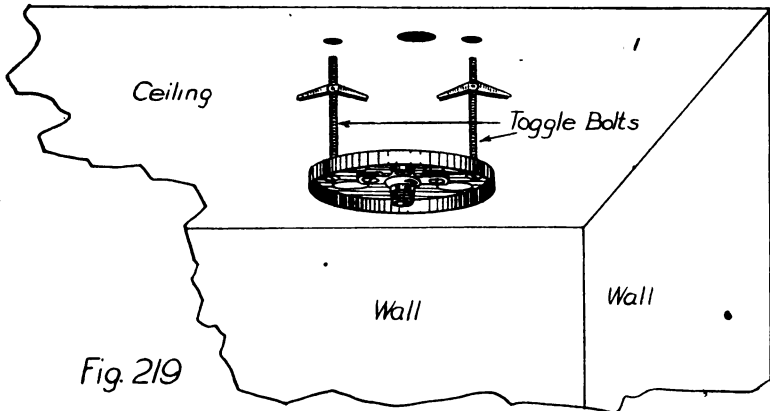


2. Place the box against the ceiling with the knock-outs placed over the holes drilled for the conduit, and spot on the ceiling the position of the holes for the toggle bolts.

Drill small holes in ceiling for the toggle bolts, making the holes just large enough for the toggle nuts to pass through.



- 3.** Install box on the plaster, using toggle bolts.
Connect conduit to box in approved manner, and bring out conductors.



- 4.** If a box hanger is used, the fixture stud is not used inside the box, but the center knock-out is removed, and the box hanger installed as in wood lath and plaster.

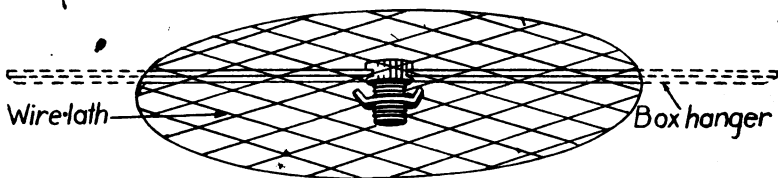


Fig. 220

Questions:

1. If necessary to remove plaster, how would the mounting be changed?
2. Can wallboard support a fixture without additional backing behind the wallboard?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing fixture outlet box in tile and plaster

References:

Cook, "Interior Wiring," p. 230.

Nelson, "Interior Electric Wiring and Estimating," p. 32.

Directions:

1. Using ovalduct box. Remove plaster after marking size of box using it as a guide. Chipping off such small pieces of tile as may extend beyond the regular surface of the tile. Do not break a hole through the tile for the box.

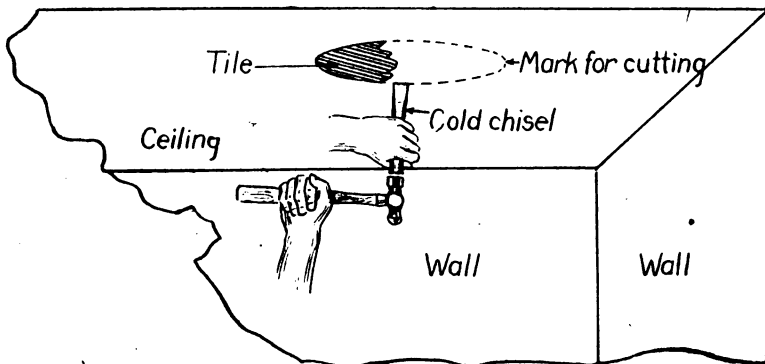
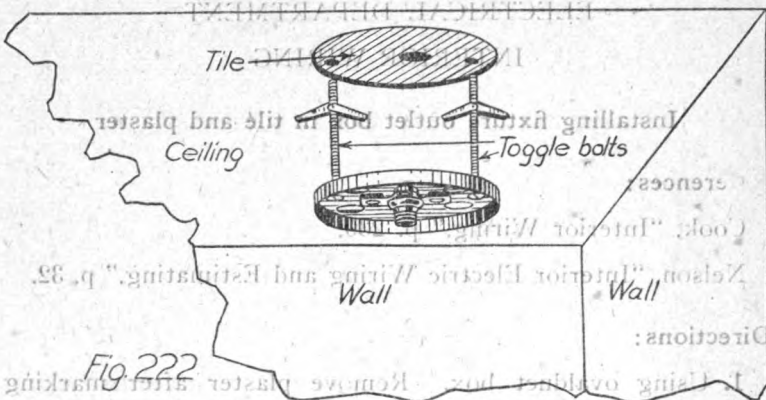


Fig.221

2. Remove the necessary knock-out from ovalduct box. Install a fixture stud to center of box, and attach to tile with toggle bolts.

Attach ovalduct to box in approved manner.



3. Using a deep box. Mark size of box on plaster and remove plaster and tile to make an opening for inserting box in tile. Great care must be taken not to break out too much tile.

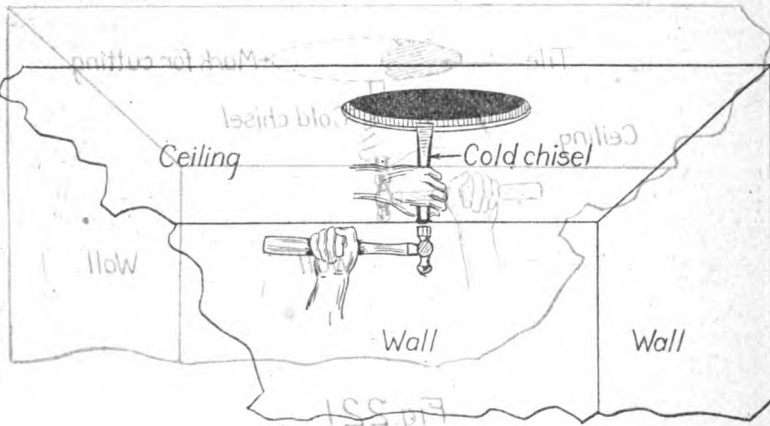


Fig. 223

4. Remove necessary knock-outs from box, install fixture stud in box, and attach box to a strap iron hanger which must be bent to rest on inside of tile. Bring edge of box flush with plaster. Attach strap iron to tile with toggle bolts.

Attach conduit to box in approved manner.

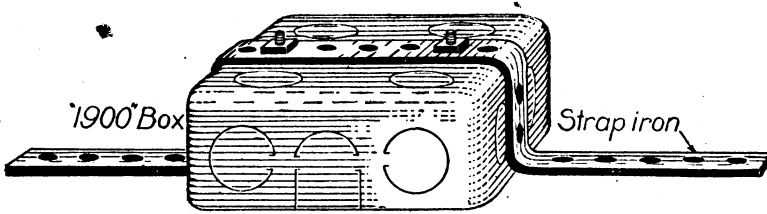


Fig. 224

Questions:

1. *Can an ovalduct box be used with flexible conduit?*
2. *Can a standard box hanger be used for supporting a deep box in tile?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing fixture outlet box for metal molding

References:

Nelson, "Interior Electric Wiring and Estimating," p. 29.

Directions:

1. New outlet. Determine position of new fixture outlet. Attach a fixture stud to center of metal molding box base and install base upon ceiling or wall with suitable screws or bolts. Attach molding to base in customary manner and bring out conductors.

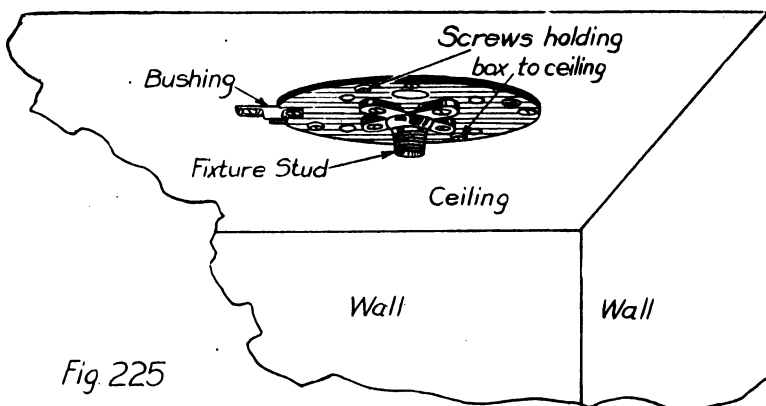


Fig. 225

2. Remove necessary knock-outs from sides of cover. Install cover in place with screws furnished with box.

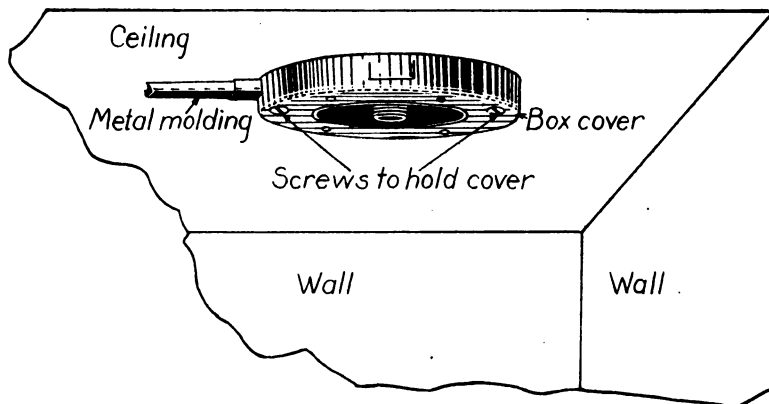
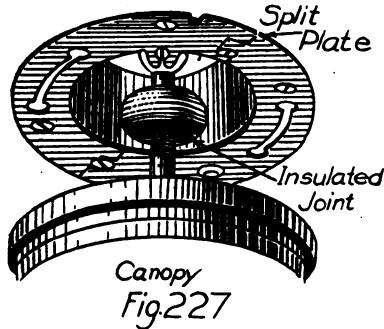


Fig. 226

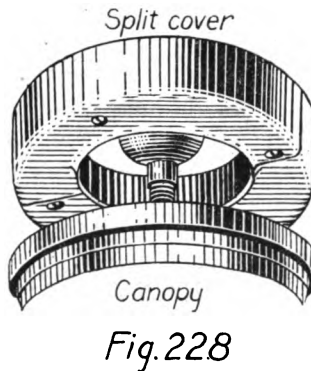
3. Tapping old outlet. Slide the fixture canopy down the fixture stem, after loosening canopy screw.

Split the adapter ring, bring it around the fixture stud or insulating coupling, and assemble ring again. Attach adapter ring to flange or ears of outlet box already found over fixture. Attach molding in customary manner, and bring out conductors.



4. Remove necessary knock-outs from sides of cover.

Split cover of box, and install around fixture stud or insulating coupling. Reassemble and fasten to adapter ring with screws furnished with box.



Questions:

1. How can molding box be attached to existing outlet box if the outlet box already installed has no ears or threaded flanges?
2. How would a tap be made from an existing outlet if the fixture at the tap was discontinued?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing cut-out and panel boxes

References:

Nelson, "Interior Electric Wiring and Estimating," p. 10.

Cook, "Interior Wiring," p. 286.

Directions:

1. Select a position for cut-out box at or near service entrance, so that entrance conduit can be attached to box. If mounted on stone, brick or open frame walls, install a wooden mounting slightly larger than the box.

Select a position for a panel box in a hall or similar place which will be accessible for controlling the circuits terminating in the panel box. Panel boxes may be mounted exposed or flush with the wall.

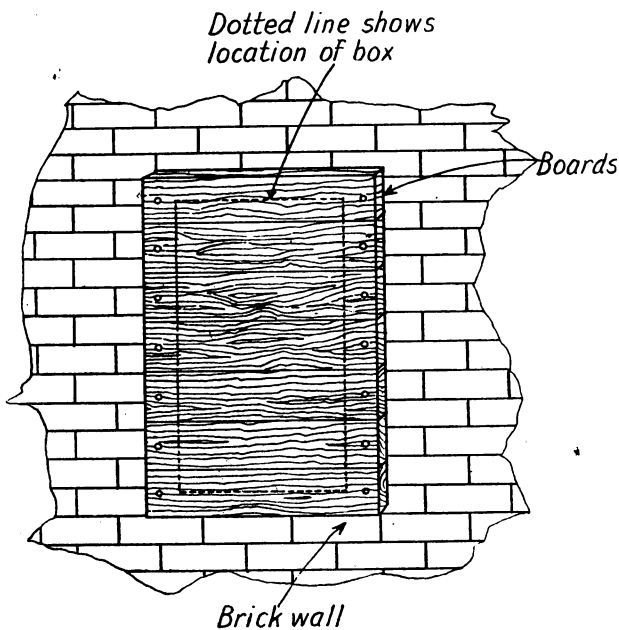


Fig. 229

2. Remove knock-outs necessary, and ream holes if necessary with standard reamer to fit conduit.

Lay the box upon the floor or bench, and arrange switches and cut-outs properly. Then mark location of holes with nail or pencil, remove switches and cut-outs, and spot all holes with a center punch.

Drill all holes in back of box for the switches and cut-outs with a twist drill slightly larger than wood screws used for switches and cut-outs.

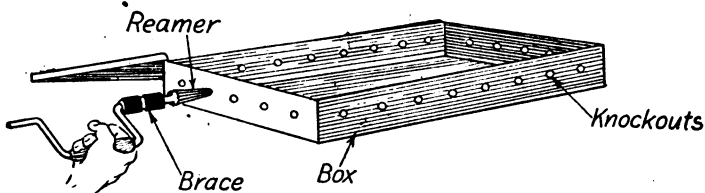


Fig. 230

3. Mount the cut-out box on wall or backing and with door swinging to right, left, or top, but never to the bottom. Make connections to conduit.

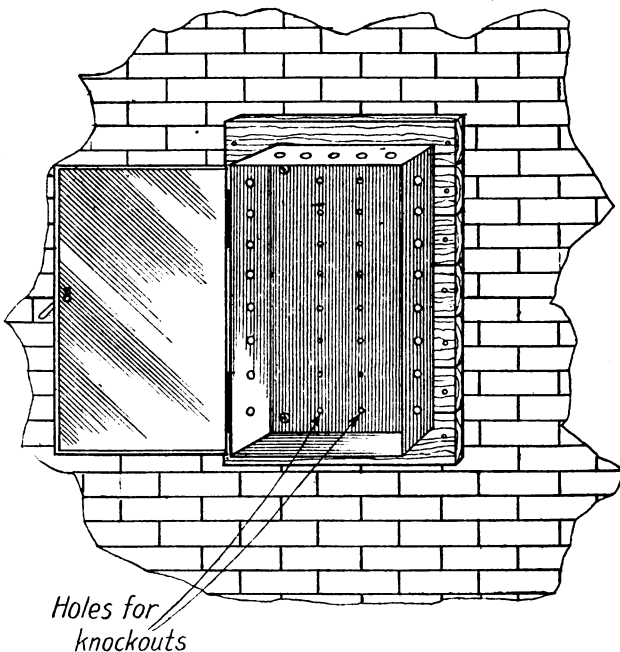


Fig. 231

4. Install cut-outs and switches using the holes drilled for the screws. Do not use machine screws or nuts for holding cut-outs and switches in boxes.

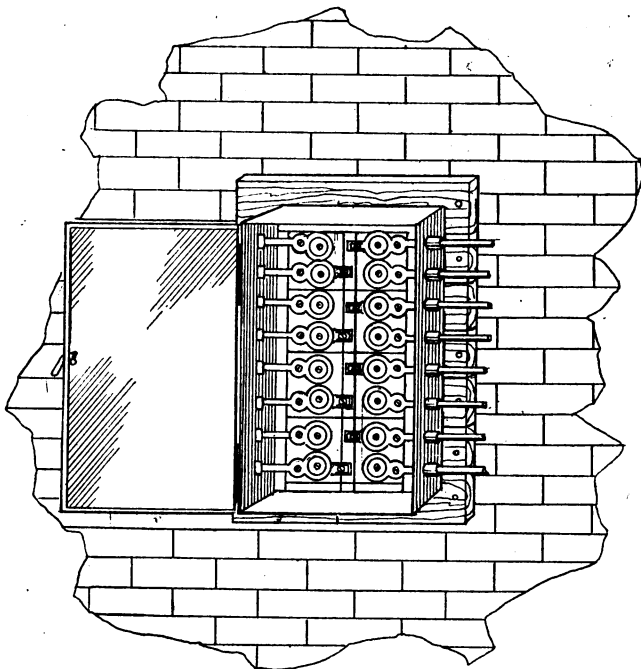


Fig.232

Questions:

1. *Why should the cut-out box be mounted on a wooden backing?*
2. *Why should machine screws not be used?*
3. *Are wooden cut-outs on panel boxes used?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing special conduit fittings

References:

Any catalogue of conduit fittings or catalogue of supply houses.

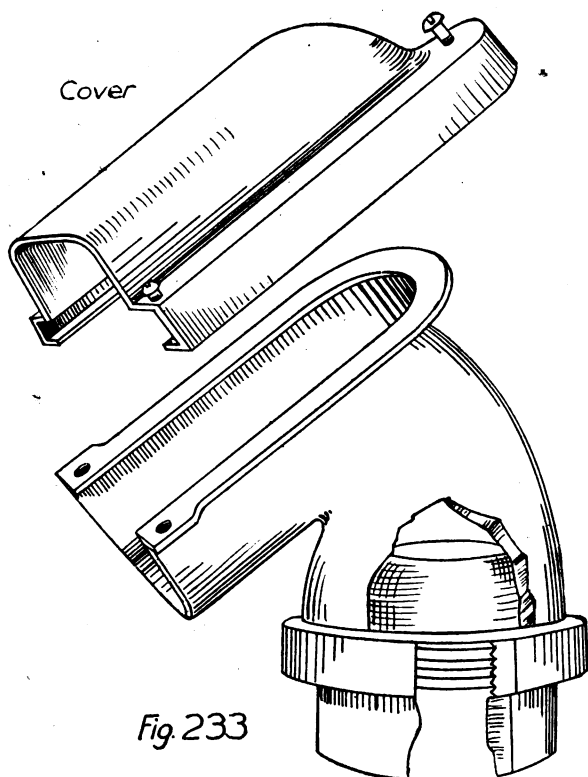
Croft, "American Electrician's Handbook," p. 492.

Cook, "Interior Wiring," p. 218.

Directions:

1. For service entrances. Select fittings when desired for the goose-neck entrance at top of service, if the conduit is not bent into a goose-neck. If bent into goose-neck, select fitting with porcelain bushing with hole for each conductor.

Make elbow turns with fittings, using either solid or covered fitting with gasket plate.



2. For motor installations. Bring conductors to motors and controllers in rigid or flexible conduit. Select fittings for elbows and outlets, using elbows if necessary as pull-boxes, and install suitable porcelain bushings in outlet fittings, using one hole for each conductor. Install flexible loom over conductors from fitting to machine.

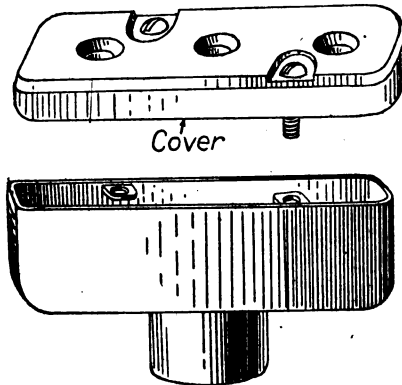


Fig.234

3. For compact exposed installations. Select fittings which will turn corners, support switches, serve as outlets, or support fixtures in the minimum space. Make all connections with rigid or flexible conduit. Make all connections of conductors in the fittings or standard outlet or junction boxes.

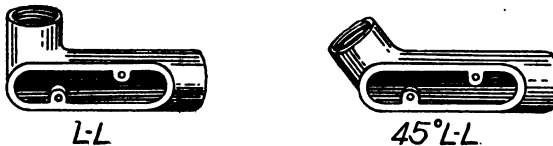
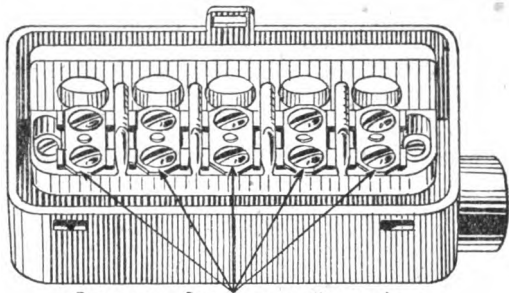


Fig.235

4. For meter terminals and loops. Select standard fittings for meter loops, and install with rigid conduit, connecting fitting to cut-out box with conduit. Connect meter to fitting with loom-covered conductors.

Make all connections to fitting, ready for meter installer who makes connection from fitting to meter. Some meter fittings have cards showing name of customer to whom meter is assigned.



Screws for connecting wires

Fig.236

Questions:

1. How are special conduit fittings designated and ordered?
2. Are meter loop fittings required by the Code?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Making an underwriter's knot

References :

Cook, "Interior Wiring," p. 281.

Sharp, "Practical Electric Wiring," p. 68.

Croft, "Wiring for Light and Power," p. 337.

Directions :

1. Separate the ends of the conductors of the twisted or duplex cord, allowing enough for the knot and for connecting the cord to the socket or receptacle.

Hold the separated ends in the form of a V, and loop one conductor **behind** the **straight** conductor.

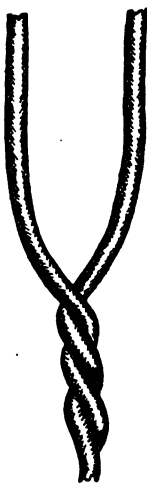


Fig 237

2. Bend the straight conductor backwards and downwards around the looped conductor.

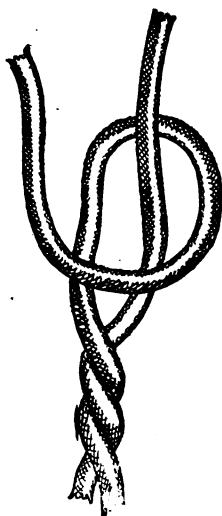


Fig. 238.

3. Pass the end of the straight conductor, which has been bent downwards, into the loop of the looped conductor.

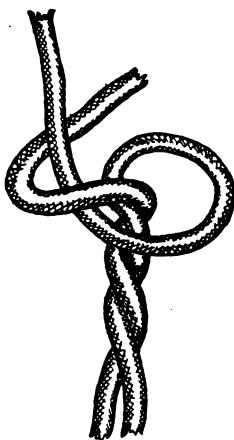


Fig. 239

4. Catch the ends of both conductors, one in each hand, and pull up the knot tightly, holding the conductors below the knot while tying it.

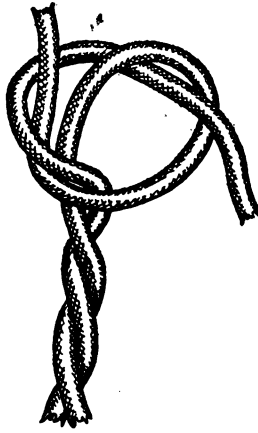


Fig.240

Questions :

1. *Why must special care be taken in tying a knot in drop cords?*
2. *How large a knot should be tied in cords?*
3. *When are Underwriters' knots used?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing drop cord

References: •

- Croft, "Wiring for Light and Power," p. 335.
Sengstock, "Electrician's Wiring Manual," p. 48.
Nelson, "Interior Electric Wiring and Estimating," p. 26.
Cook, "Interior Wiring," p. 283.

Directions:

1. Open wiring. Select an approved rosette among the types available. Insert drop cord through hole in rosette, attach rosette to running board or ceiling, and splice ends of drop cord to conductors. Tie an Underwriters' knot in cord at the rosette and in the socket.

If no rosette is available, a split knob or two cleats may be used to support the cord at connection to conductors.

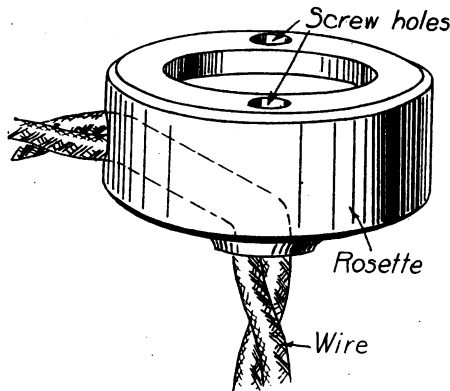


Fig. 241

2. Concealed knob and tube wiring. Select a separable concealed wiring rosette. Detach base of rosette, slip conductors through holes in base and attach base to ceiling with wood screws. Connect conductors to base terminals. Connect drop cord to rosette cap terminals, using an Underwriters' knot in cap and in socket. Attach cap to base with screws.

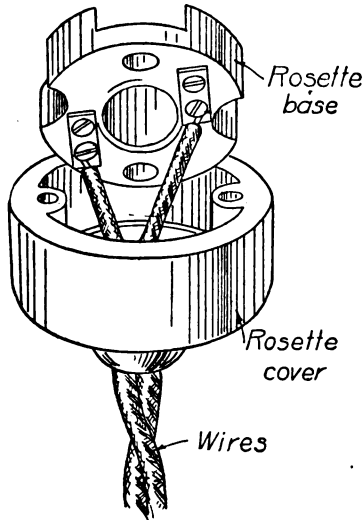


Fig. 242

3. Wooden or metal molding. Select a suitable drop cord rosette. Cut or space the capping to allow for rosette. Install porcelain connector within molding, attaching main line conductors to connector.

Pass drop cord through rosette cap, making an Underwriter's knot, and attach ends of cord to porcelain connector in molding. Screw rosette cap to molding in wooden molding, or to fitting in metal molding.

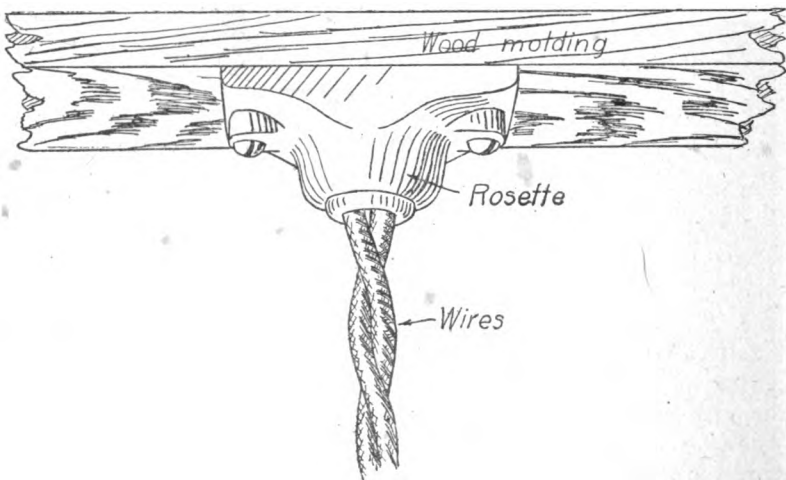


Fig. 243

4. Standard conduit box. Select pendant cover with insulating bushing for cord. Pass drop cord through bushing, making an Underwriter's knot, allowing sufficient cord for splicing in box.

Splice cord to main conductors in box, and screw pendant cover to box flange.

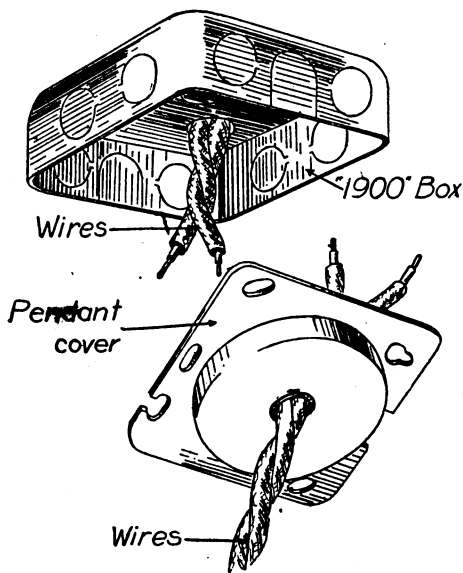


Fig. 244

Questions:

1. How can the length of a drop cord be adjusted?
2. What kinds of cords are used for drop cords?
3. Is it permissible to draw drop cords out of line with the rosette, as over desks or beds?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing fixture with crowfoot

References:

- Croft, "Wiring for Light and Power," p. 330.
Sengstock, "Electrician's Wiring Manual," p. 44.
Cook, "Interior Wiring," p. 75.

Directions:

1. Install a suitable board or other wooden hanger to which crow-foot can be attached if crow-foot cannot be attached direct to wall or ceiling.

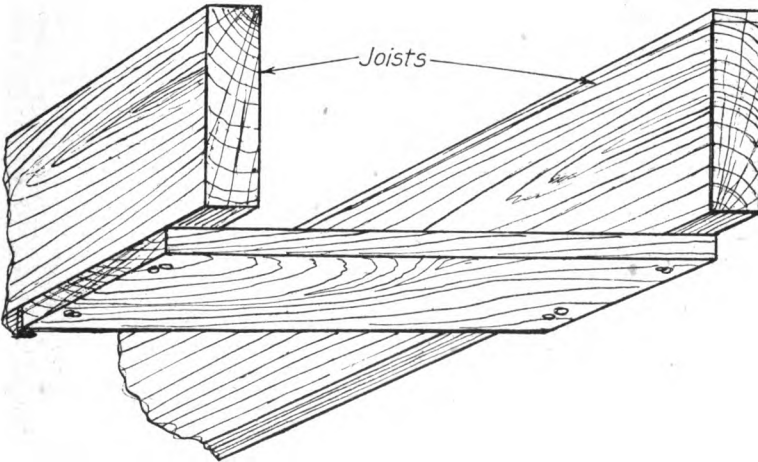


Fig. 245

2. Screw fixture direct into crow-foot without "hickey" or insulating joint, unless crow-foot is attached to a metal or conducting surface, in which case the insulating joint must be used.

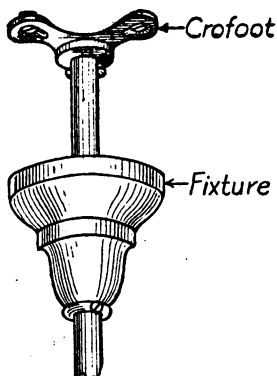


Fig. 246

3. If no canopy is used, the conductors from the fixture must be of sufficient length to be attached direct to the main line conductors, and must be supported under a cleat or knobs.

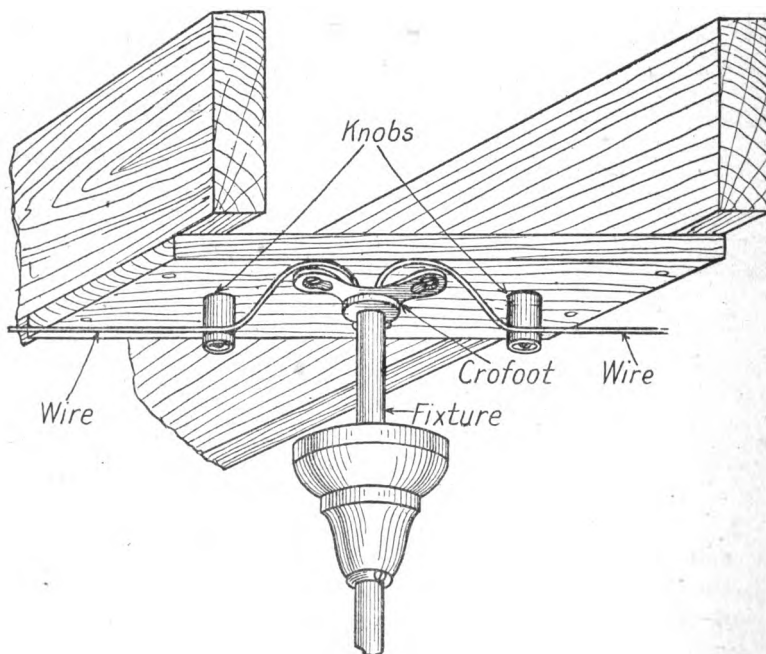
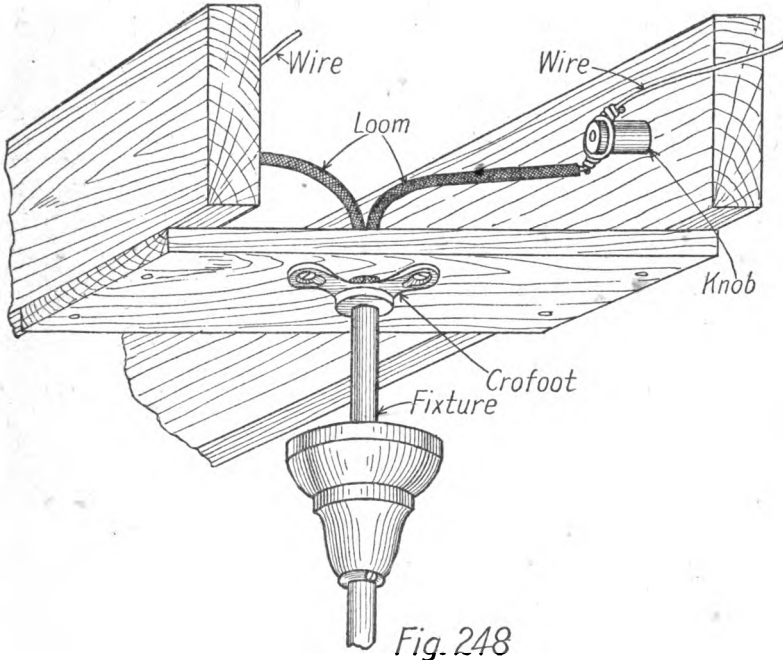


Fig. 247

4. If canopy is used, the main conductors should be brought through the supporting board and crow-foot in tubes or loom.

Connect fixture conductors to main line conductors, solder and tape joints around crow-foot. Replace canopy, taking care not to force the joints against the ceiling or wall with the canopy.



Questions:

1. In what system of wiring is crow-foot construction made?
2. How does a crow-foot differ from a fixture stud?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing fixture on gas outlet in outlet box

References:

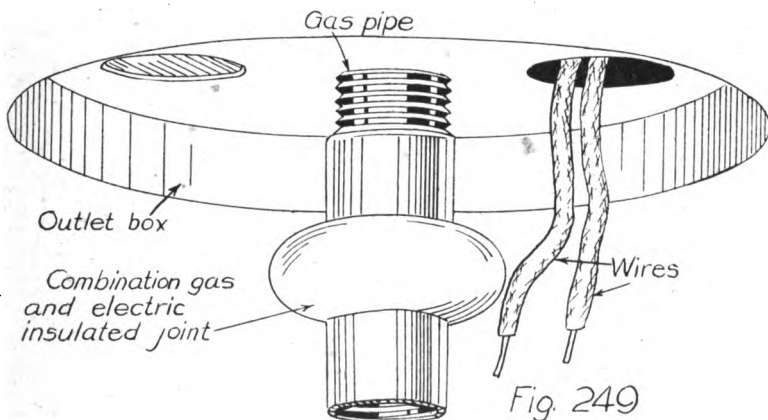
Sharp, "Practical Electric Wiring," p. 122.

Cook, "Interior Wiring," p. 71.

Directions:

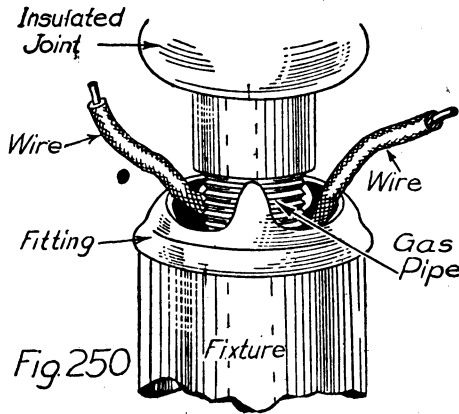
1. Remove gas fixture and shorten outlet if necessary. Install a combination gas and electric insulating joint, using paint in the threads of the joint to make the connection gas-tight.

Ordinary red or white lead is liable to run over the edge of the insulating joint and ground the fitting.



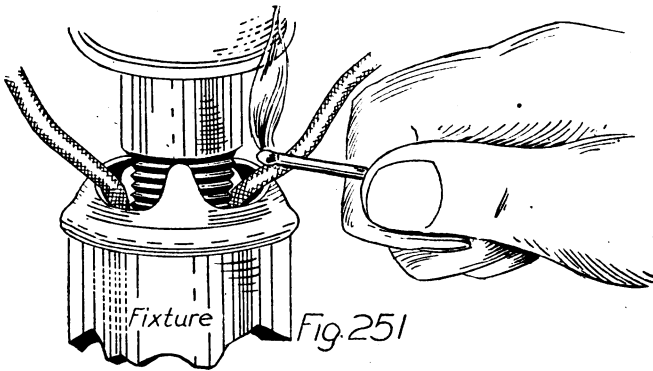
2. Inspect end of brass shell of fixture to see that a suitable, rounded fitting is placed over the end to prevent cutting of fixture wires.

Bring out conductors on opposite sides of fitting.



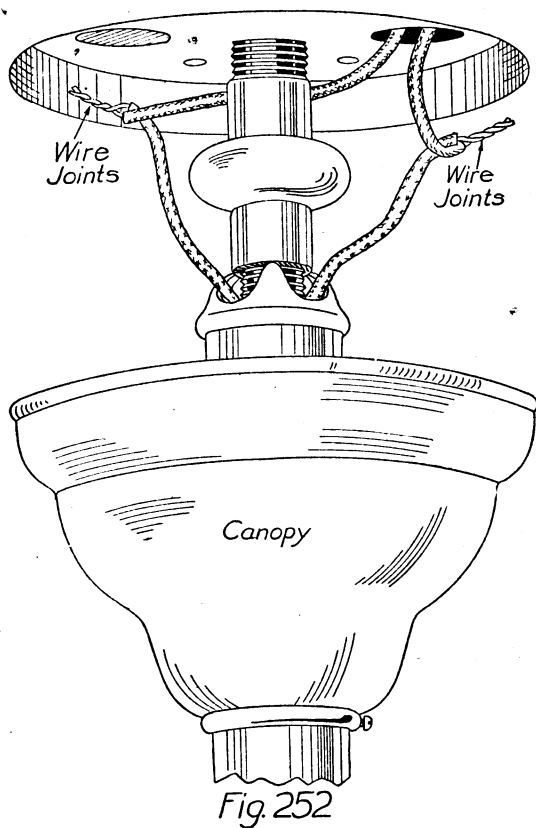
3. Apply paint to threaded gas pipe of fixture, and screw fixture in position, watching that sockets or outlets of the fixture are in proper position with respect to the room.

Make all connections to line conductors with fixture joints. Solder and tape joints. Test gas connection for leak.



4. Tuck the taped joints carefully into fixture outlet box so that no conductors touch the plaster.

Run the canopy to the ceiling, and hold it in position by screwing up the set-screw to the fixture stem.



Questions:

1. *What kind of compound paint should be used for joints?*
2. *Why cannot a fixture "hickey" be used with a combination fixture?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing fixture on stud in outlet box

References:

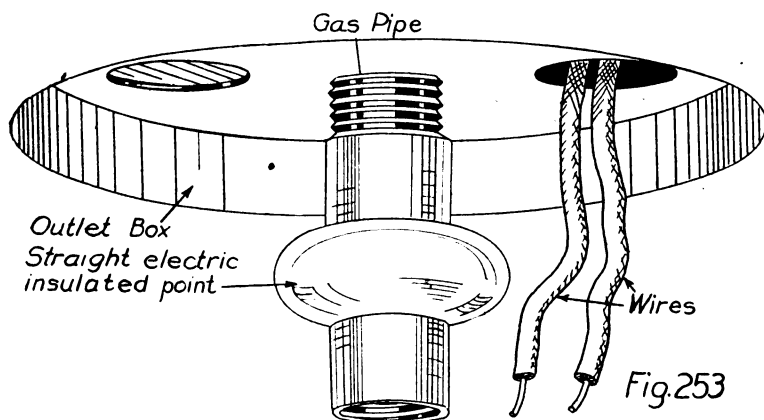
Croft, "American Electrician's Handbook," p. 438.

Sharp, "Practical Electric Wiring," p. 122.

Cook, "Interior Wiring," p. 72.

Directions:

1. Screw an approved insulating joint, using the straight electric type, on the fixture in the outlet box.



2. Screw a fixture "hickey" on the end of the fixture pipe. Inspect the "hickey" to see that it is threaded properly to be attached to the fixture in one end and the stud in the other. Bring the conductors from the fixture through the side opening of the "hickey," having one conductor on each side of the "hickey."

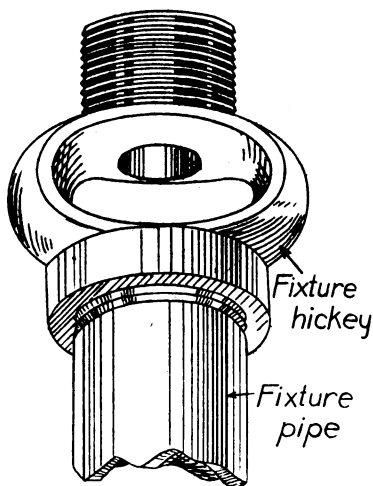
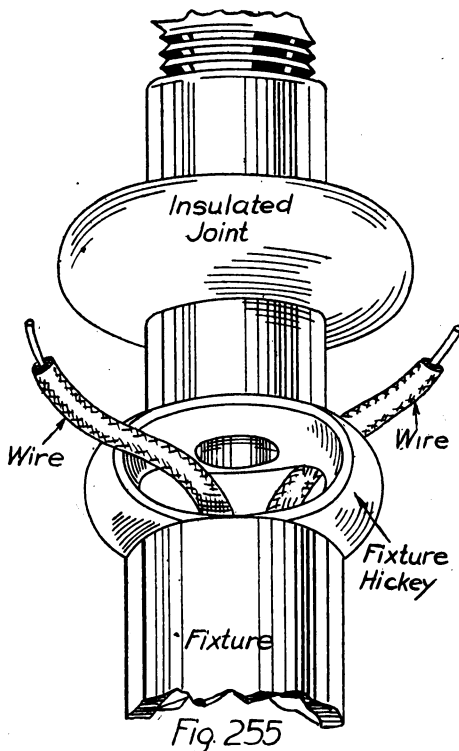


Fig. 254

3. Screw up the fixture on the insulating joint, bringing the fixture in position so that sockets or outlets are in correct position with respect to the room.

Make all connections to line conductors with fixture joints. Solder and tape joints.



4. Tuck the taped joints carefully into fixture outlet box so that no conductors touch the plaster.

Run the canopy to the ceiling, and hold it in position by screwing up the set-screw to the fixture stem.

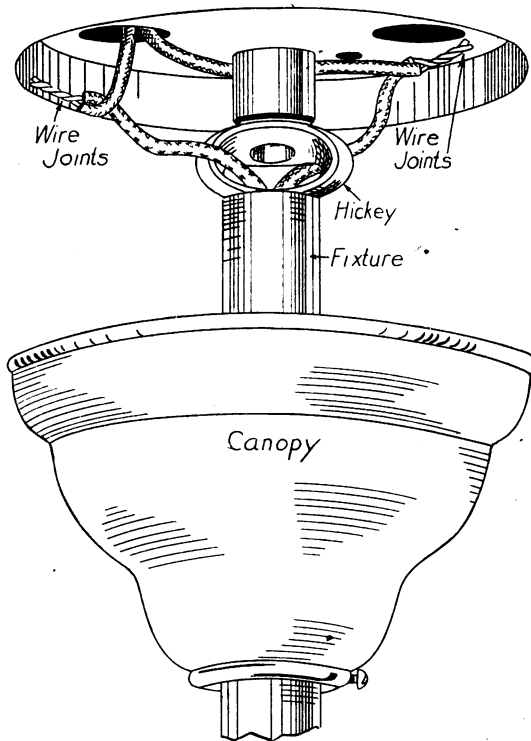


Fig. 256

Questions:

1. *What is the purpose of the insulating joint?*
2. *What is the purpose of the canopy insulating ring?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing a chain fixture

References:

Croft, "Wiring for Light and Power," p. 328.

Cook, "Interior Wiring," p. 69.

Directions:

1. Install a straight electric insulating joint on gas drop or fixture stud.

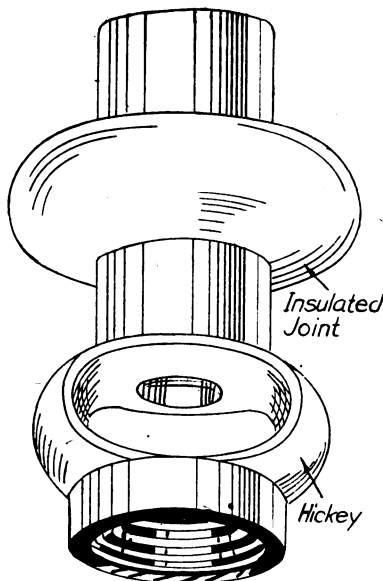


Fig 257

2. Cut canopy nipple to proper length with a hack-saw, and screw nipple into the insulating joint securely.

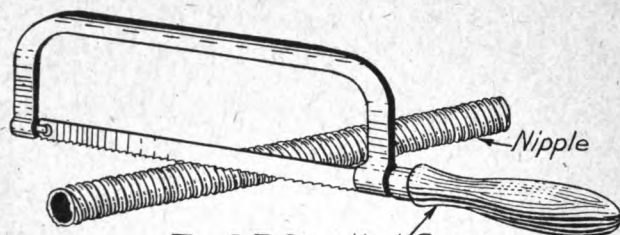


Fig. 258 Hack Saw

3. Bring canopy with fixture chains and fixture wires to outlet box. Splice and tape fixture wires to main conductors. Tuck joints carefully into outlet box.

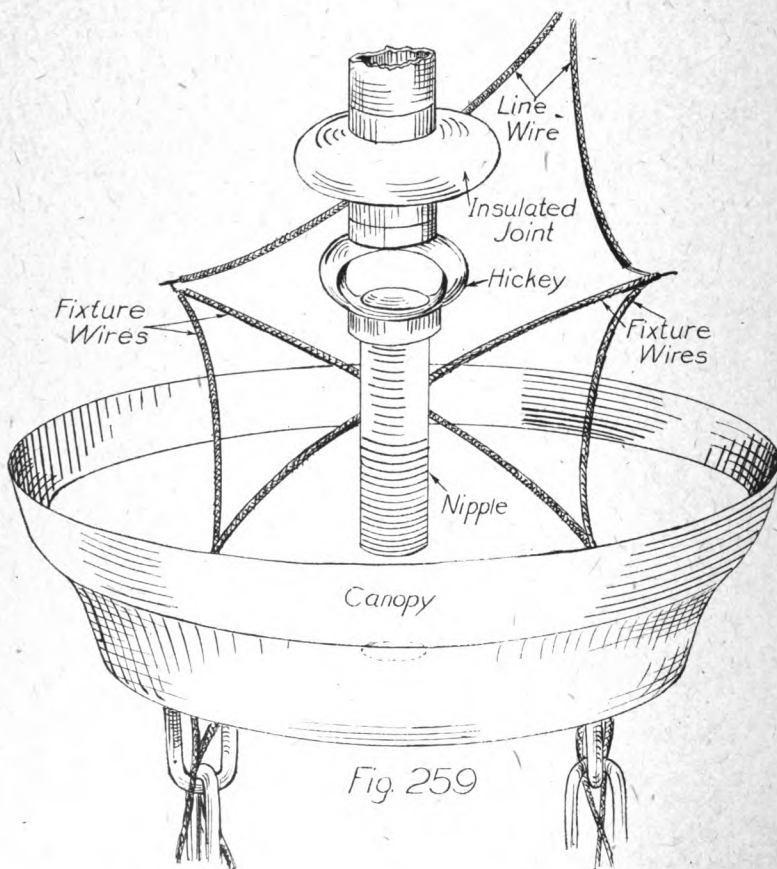
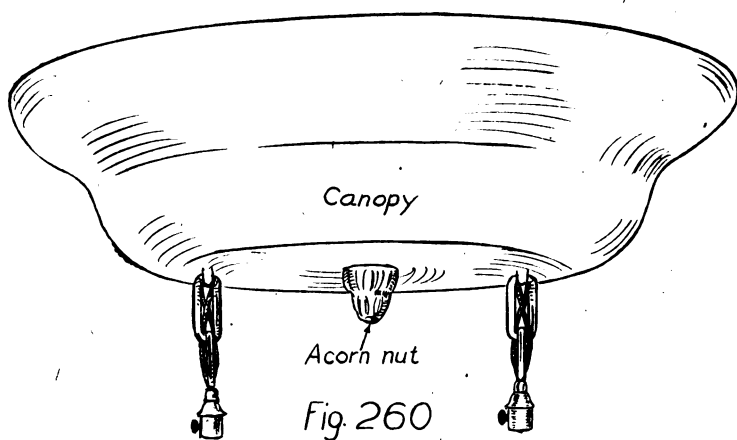


Fig. 259

4. Slide canopy over nipple and against the ceiling. Hold canopy in position and screw acorn nut over end of nipple

until tight. A lock-nut on inside of canopy on the canopy nipple holds the canopy more firmly than if it is held only with the acorn nut.

Install bowl and other attachments to chains.



Questions:

1. Can splices be made after fixture is in place?
2. Is an insulating canopy ring necessary on a chain fixture?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing flush switch or receptacle

References:

Cook, "Interior Wiring," p. 214.

Sharp, "Practical Electric Wiring," p. 97.

Directions:

1. Select proper size and type of switch or receptacle for the outlet and box installed.

Separate conductors issuing from the switch box, bending the separated conductors to fit inside of box, allowing room for the installation of the switch or receptacle. Allow sufficient length of conductor to make connections to switch.

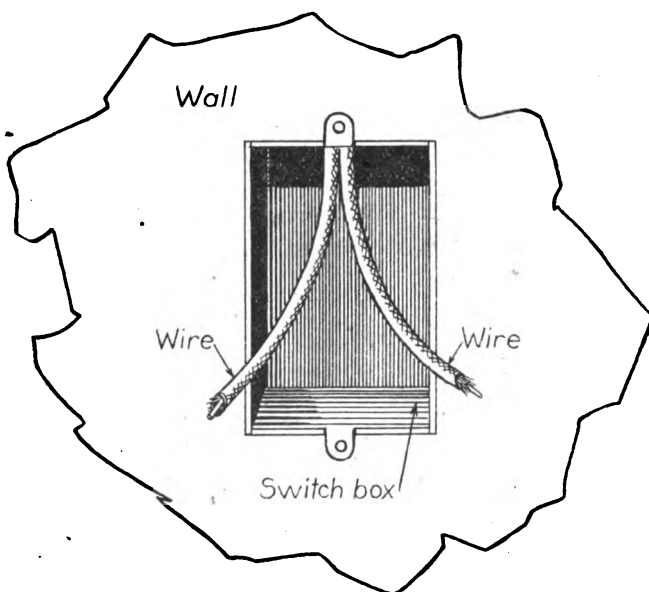


Fig. 261

2. Insert switch or receptacle into box, bringing the switch ears against the flange on the box. Determine whether leveling washers are required under switch ears to bring it level with surface of the walls. Estimate the number of washers required for leveling, if needed.

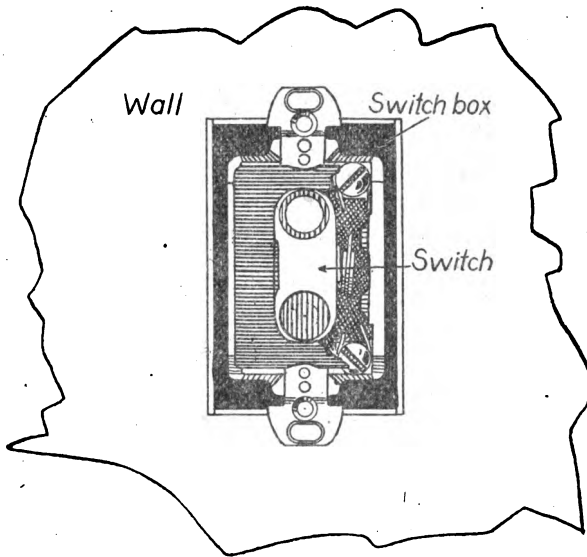


Fig.262

3. Remove switch from box, slip the required number of leveling washers under each screw and replace switch in box, screwing it up tightly to box, and test for alignment. If switch is not straight, loosen screws and twist switch into position.

Attach conductors to switch terminals, bending the ends of conductors in correct direction so that tightening of terminal screws will not loosen the conductors.

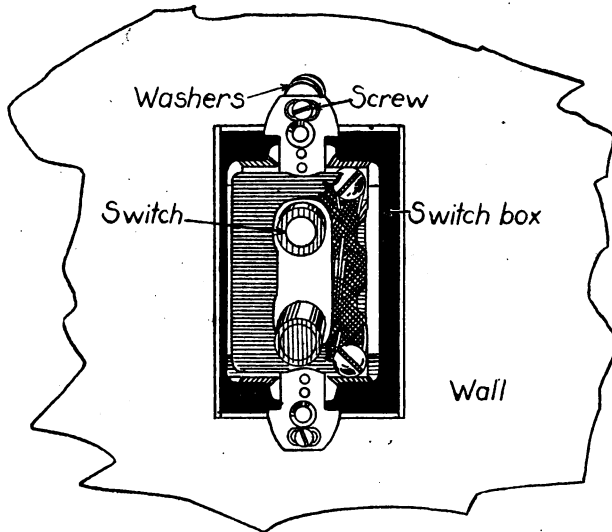


Fig. 263

4. Install switch plate over buttons or receptacle, and inspect for neatness and alignment with wall.

Inspect for position of buttons, and see that buttons are in correct positions, especially in gang switches.

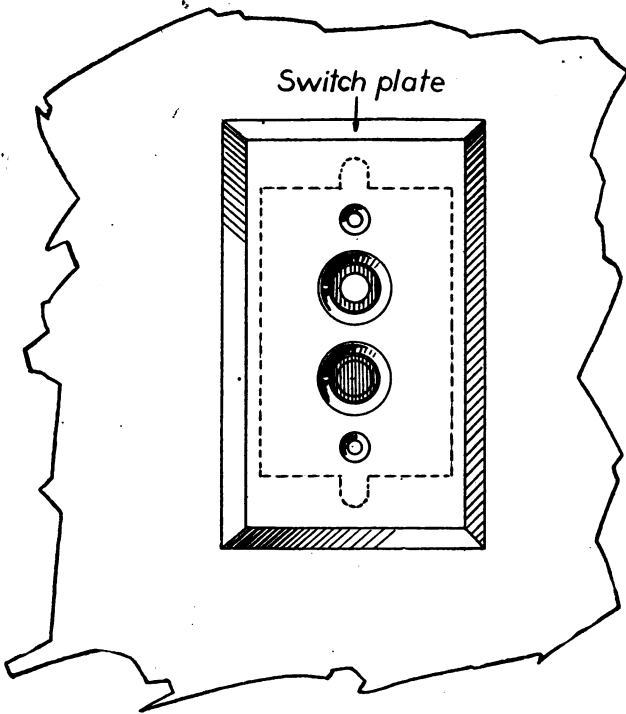


Fig.264

Questions:

1. *What is the proper height of a switch outlet above the floor?*
2. *In a push-button switch, is the white or the black button uppermost?*
3. *What precaution must be taken in connecting a "polarity" receptacle?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing snap switch on spider cover

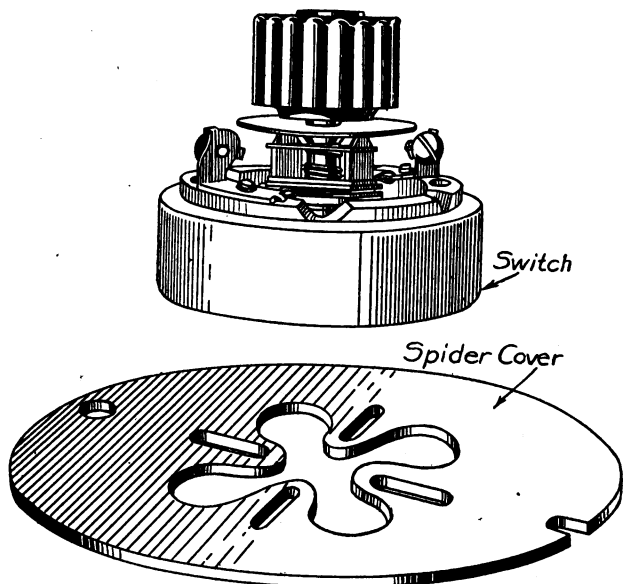
References:

Nelson, "Interior Electric Wiring and Estimating," p. 53.

Directions:

1. Attach a spider cover, selected to fit the outlet box to which the switch will be attached, to the base of the switch.

Use machine screws, placing the round heads of the screws within the switch, and the nuts under the spider cover.



2. Pass the conductors through the spider cover and switch, allowing sufficient length of conductor for connecting to switch terminals.

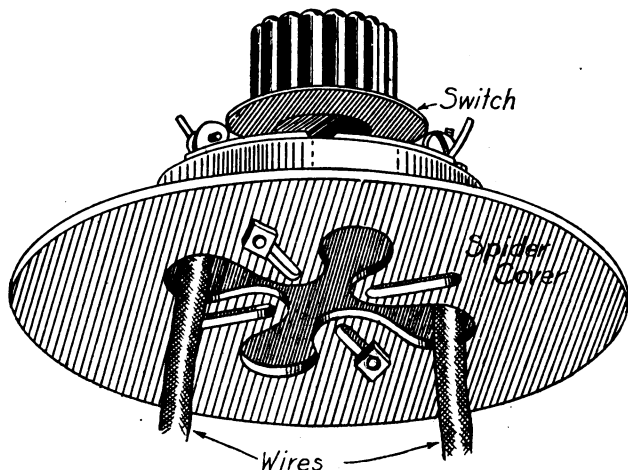


Fig. 266

3. Attach the spider cover and switch to the box, using the small screws in the box flange.

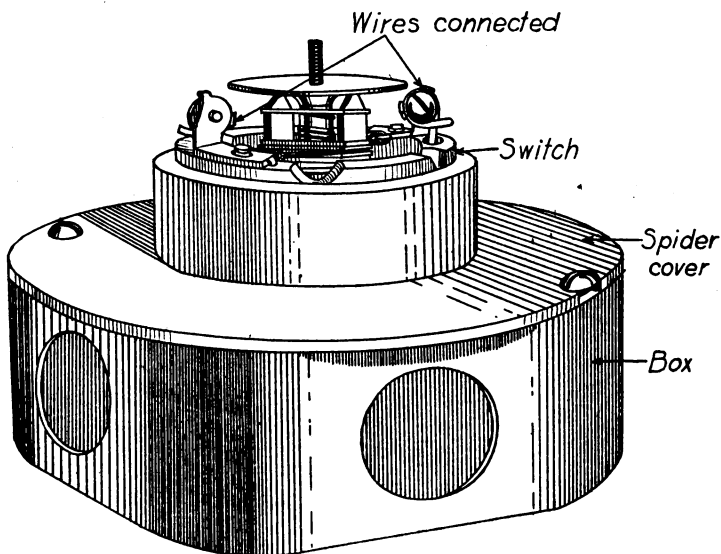


Fig. 267

4. Connect conductors to switch terminals, replace cover and button of switch.

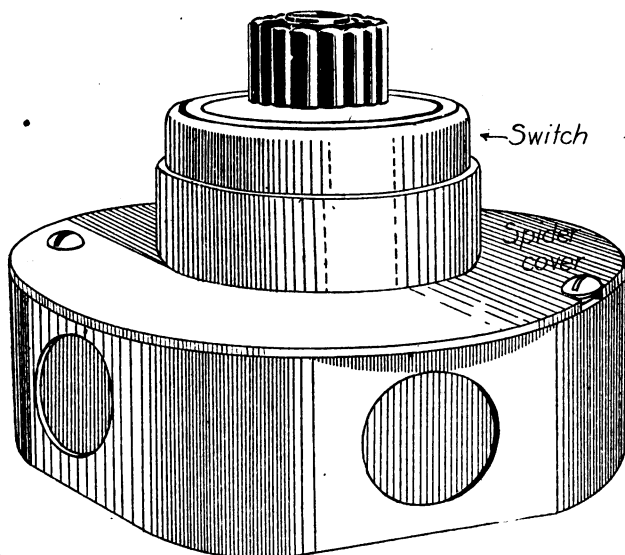


Fig.268

Questions:

1. *Can receptacles or sockets be installed on spider covers?*
2. *In what cases are spider mountings used for switches?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Installing snap switch for knob and cleat wiring

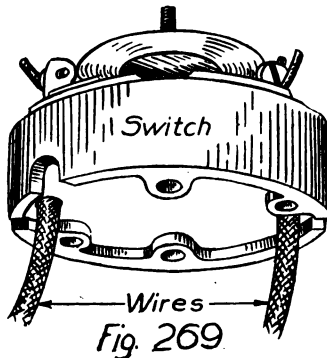
References:

Croft, "American Electrician's Handbook," p. 447.

Croft, "Wiring for Light and Power," p. 246.

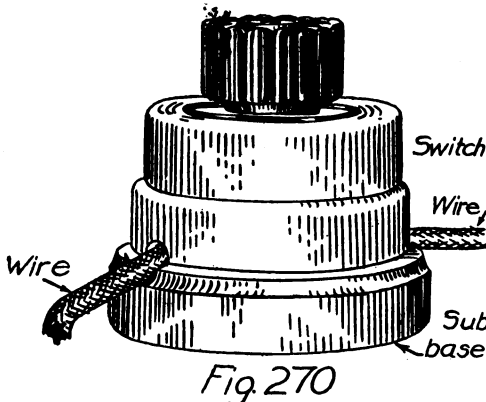
Directions:

1. Open wiring. Pass conductors through base of snap switch, but do not attach to switch terminals.



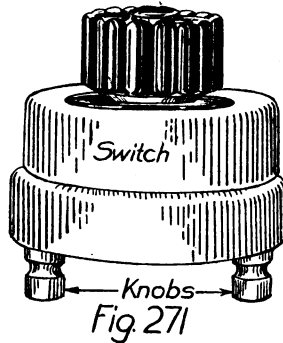
2. Place a porcelain, approved sub-base under the switch, fitting conductors into grooves in sub-base. Install switch and sub-base on wall by passing wood screws through switch base and sub-base.

After switch is mounted, pull conductors up tightly, and fasten them to switch terminals.



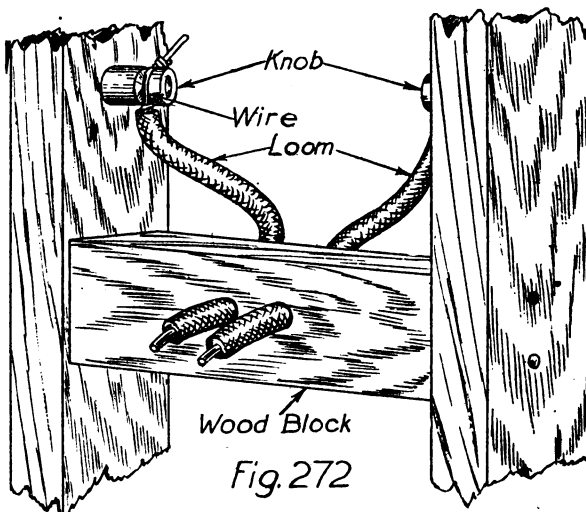
3. If an approved sub-base is not available, mount switch as outlined above, but use two short knobs instead of the sub-base, passing switch screws through the knobs.

Mount conductors as in case of sub-base.



4. Concealed wiring. Drill holes in a wooden block for conductors. Pass conductors through holes in block, being sure that loom covering of conductors also comes to surface of wood block. Mount block on wall, pass conductors through switch base, and attach switch to wood block.

Pull up conductors tightly, and attach them to switch terminals.



Questions:

1. *Why is a sub-base necessary for the snap switch?*
2. *Why should conductors be attached to switch after switch is installed and not before it is installed?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing switch or receptacle on wooden molding

References:

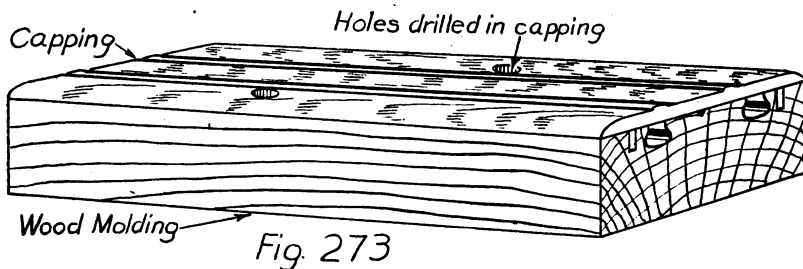
Sengstock, "Electrician's Wiring Manual," p. 16.

Nelson, "Interior Electric Wiring and Estimating," p. 25.

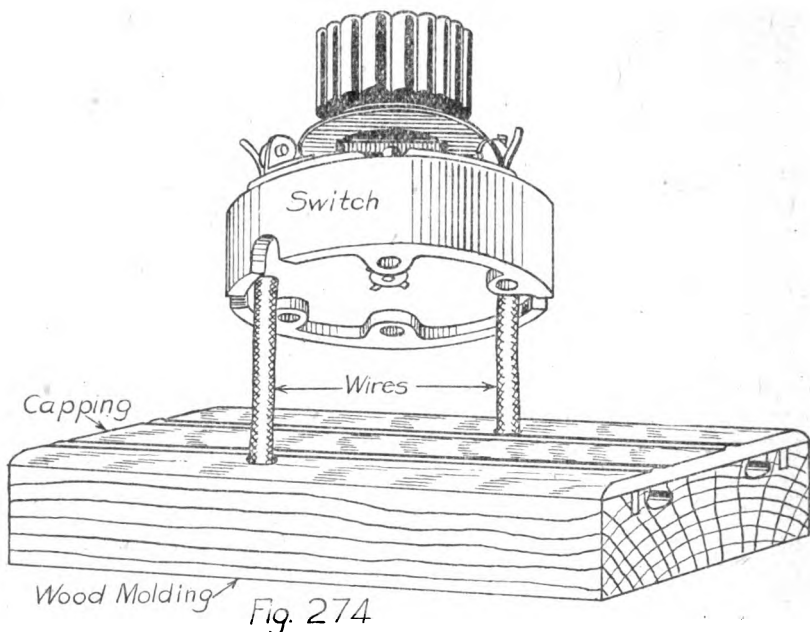
• Directions:

1. Select switch or receptacle to fit the molding. A small switch should be used for neatness. Receptacles can be selected to fit molding exactly.

In case of switch drill holes in capping immediately over grooves in base of molding to allow conductors to enter switch. In case of receptacles, cut the capping to allow receptacle to drop into place over base.

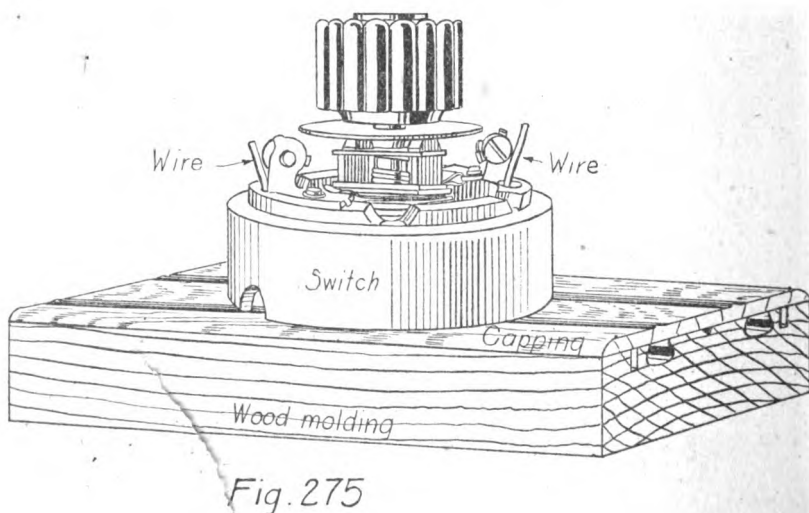


2. Pull conductors through switch base and capping or through base of receptacle, allowing sufficient length for connection to switch or receptacle.



3. Attach switch to capping, taking care not to run the screws into the conductors in the molding.

In case of a receptacle, attach the receptacle direct to molding, and fit the capping against the receptacle.



4. Attach conductors to terminals of switch or receptacle. Replace switch or receptacle cover, and examine for looseness.

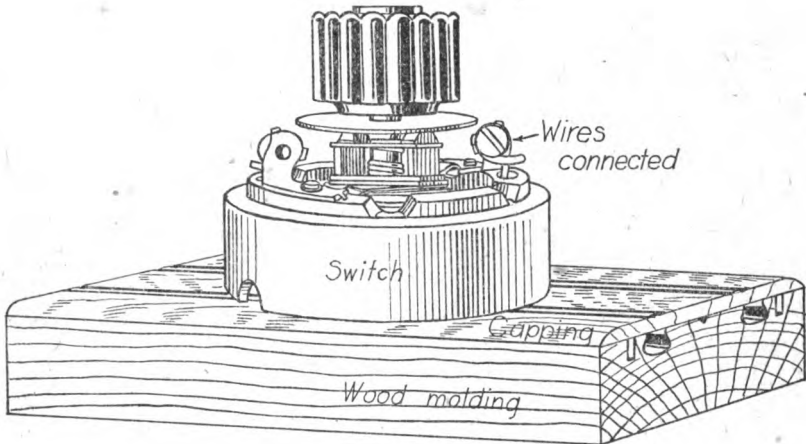


Fig.276

Questions:

1. Why is it necessary to run the switch screws through the capping into the molding base below?
2. How can the switch screws be brought through the capping without cracking the capping?
3. How is the inside member of the receptacle held in place?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Making rat-tail splices

References:

- Sharp, "Practical Electric Wiring," p. 11.
- Croft, "American Electrician's Handbook," p. 93.
- Nelson, "Interior Electric Wiring and Estimating," p. 6.

Directions:

1. Remove the insulation from the conductor with a knife, never use cutting pliers. Care must be taken not to nick or cut the wire, since it will break easily when so damaged. Do not cut the insulation at right angles to wire, but at a slant to avoid damaging the conductor.

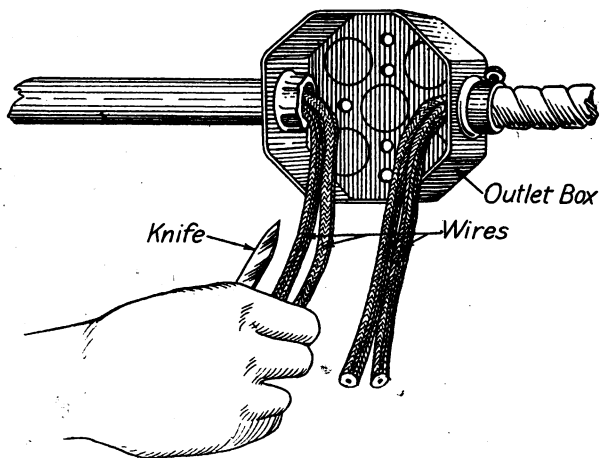


Fig. 277

2. Scrape the conductors to be connected. All rubber and other material must be removed, since it prevents good contact between the conductors at the joint, and it also hinders the work of soldering the joint later.

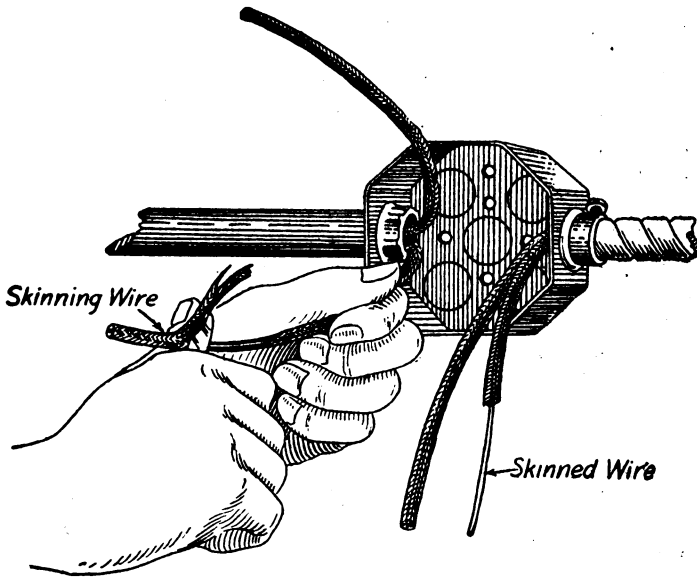


Fig. 278

3. Determine which conductors must be twisted together. Cross the pair between the fingers, and twist them together for a distance of at least an inch. Several conductors may be twisted together in the same manner. For heavy wire, the pliers must be used for twisting.

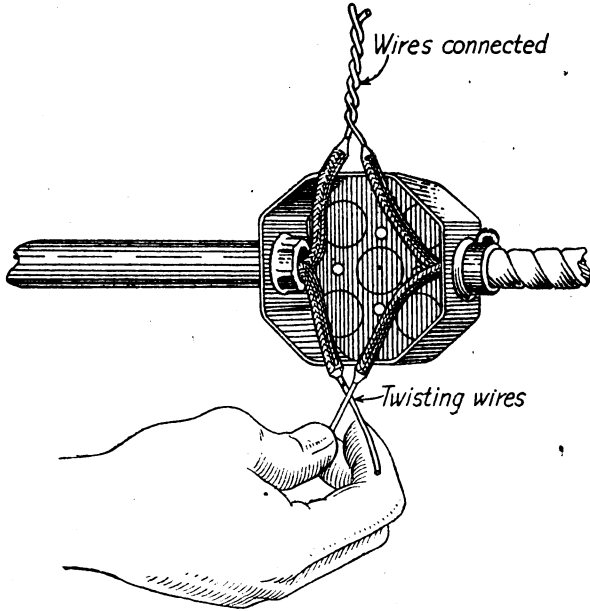
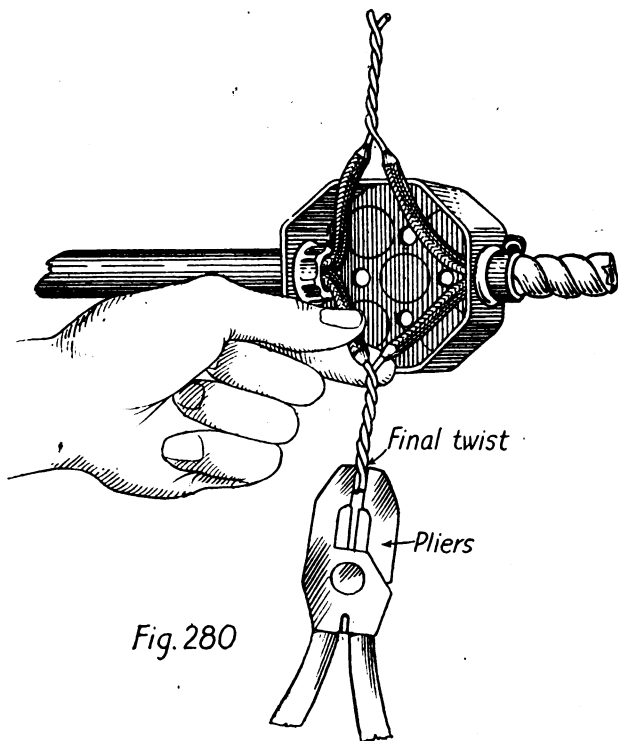


Fig. 279

4. The final twist must be made with a pair of pliers, and the unnecessary wire cut off to make a neat splice. After splicing, pull the spliced ends out of the box and away from surrounding walls or supports until the final circuit tests are made.



Questions:

1. *Why is it important to make a good mechanical joint, even if soldered?*
2. *Is the rat-tail joint a good joint if liable to a strain?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Making a fixture joint

References:

Sharp, "Practical Electric Wiring," p. 18.

Croft, "American Electrician's Handbook," p. 93.

Directions:

1. Remove about three inches of insulation from main line conductors and from fixture wire.

Use great care not to nick or cut the fixture wire which is No. 18 wire, and is easily damaged and broken.

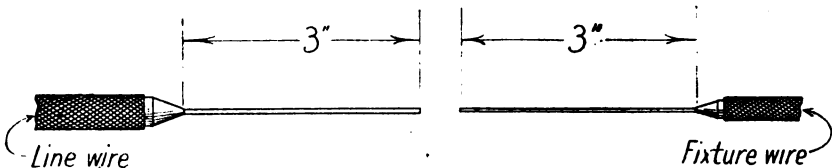


Fig. 281

2. Twist the fixture wire around the main conductor to a point about one inch from the end of the main conductor.

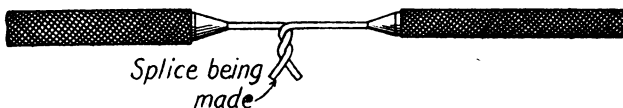


Fig. 282

3. Bend the main conductor back upon itself, squeezing the bend with a pair of pliers.

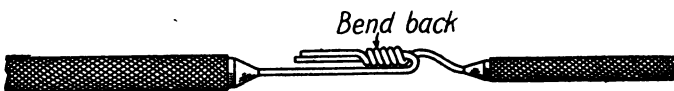
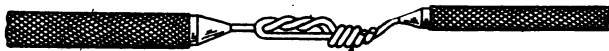


Fig. 283

4. Complete the joint by wrapping the remainder of the fixture wire around the bent main conductor and back to the straight portion of the main conductor.

Cut off any excess wire which might project through the insulation of the joint.



Final Connection

Fig. 284

Questions:

1. *What is the objection to a standard rat-tail joint in fixtures?*
2. *Is any greater care required in splicing conductors of different sizes than in splicing conductors of the same size?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Splicing stranded conductors

References:

Sharp, "Practical Electric Wiring," p. 20.

Nelson, "Interior Electric Wiring and Estimating," p. 8.

Croft, "American Electrician's Handbook," p. 94.

Directions:

1. Remove insulation from both conductors, revealing all strands of both conductors to be spliced. Fan out the outer layer of strands, and cut off squarely the center core of strands remaining, making each core about half the length of the fanned strands around them.

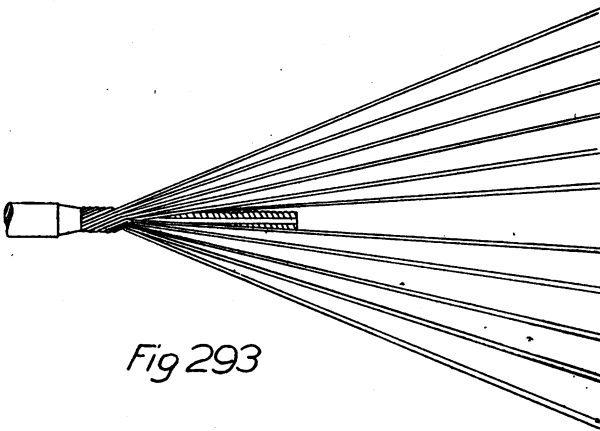


Fig 293

2. Bring both stranded conductors together, making the center cores butt against each other. The stranded conductors which are fanned, must alternate with each other in position.

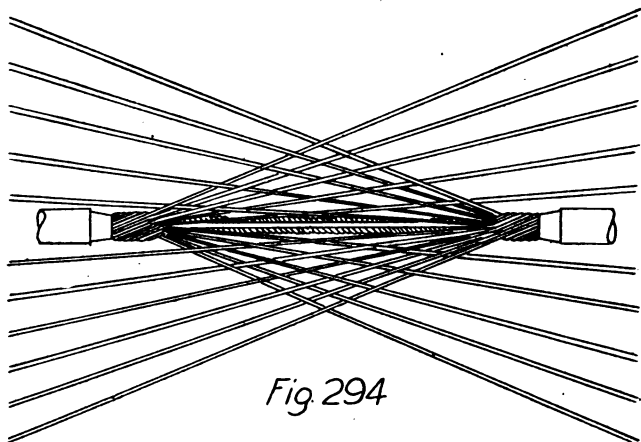


Fig. 294

3. Bring all the fanned conductors down against the core, and select one strand from each main conductor, twist them around each other, and then twist the ends in opposite directions around the strands which are lying flat with the core.

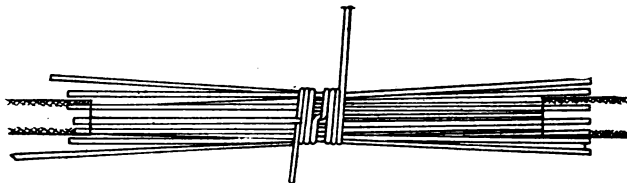


Fig. 295

4. At the points where the two strands have made three or four twists, cut them off and take up the next pair of strands which happen to lie under the end of the first pair. Twist the second pair of strands in the same direction as the first, and where they end, pick up a third pair, and so on, until all the strands have been twisted around the core in the same manner.



Fig. 296

Questions:

1. *Why should stranded conductors not be spliced in the form of a Western Union joint?*
2. *Are splices made in this manner in lamp cord or small stranded conductors?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Starting a blow-torch

References:

Sharp, "Practical Electric Wiring," p. 24.

Directions:

1. After the torch has been filled partly full with gasoline open the valve at the bottom of the hand pump, and pump air into the torch until the pressure seems sufficient or until the pumping becomes difficult. After sufficient pressure is accumulated, close the valve under the hand pump.

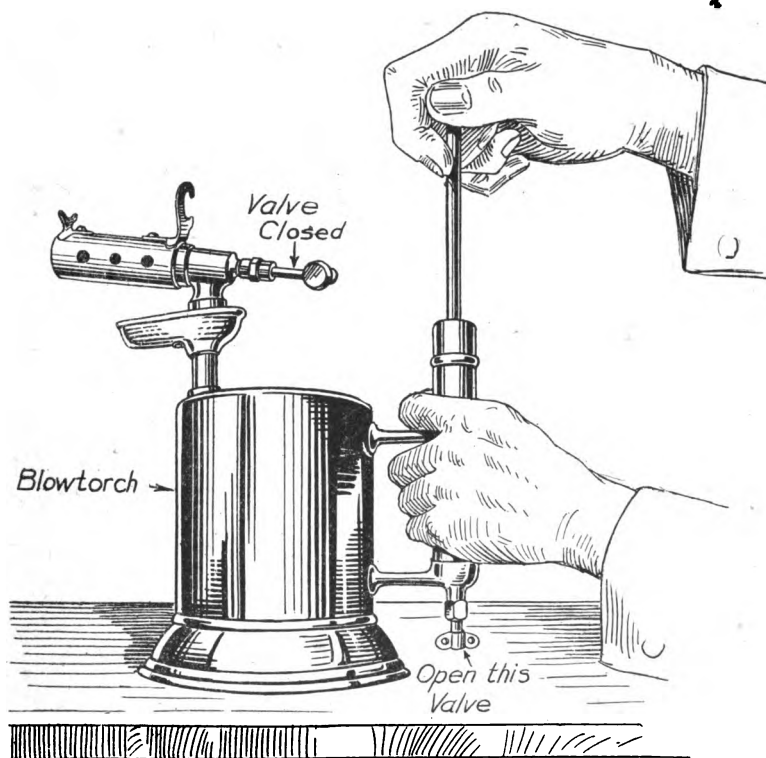
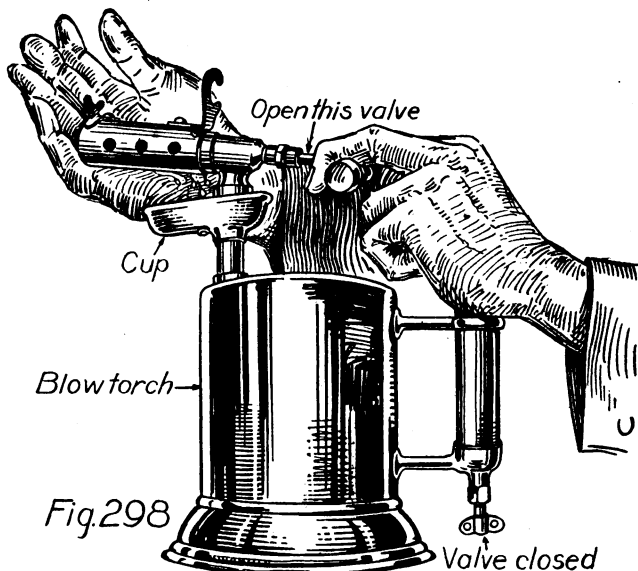
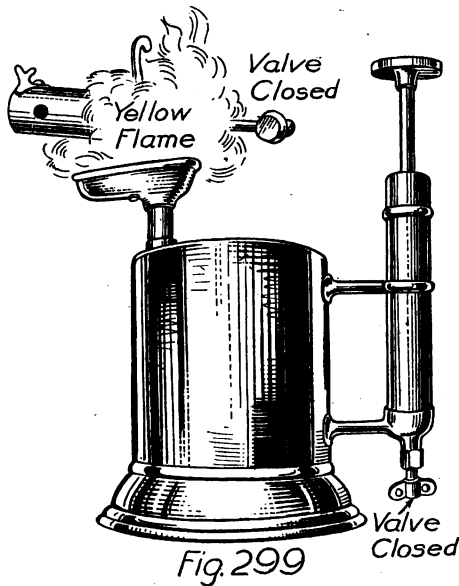


Fig. 297

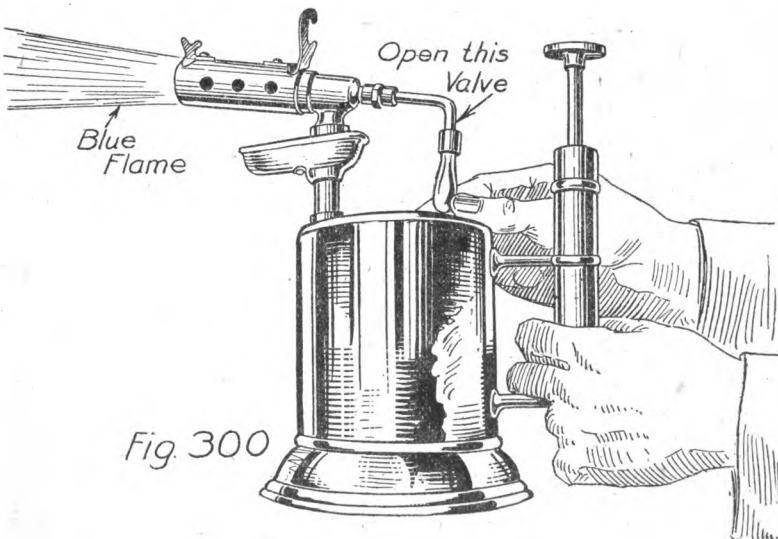
2. Place the torch in a place in which there is no great danger of fire, place the hand over the end of the torch, open the needle valve in the torch, and allow the cup under the torch to fill with gasoline. The torch should be tipped backwards slightly to catch all the gasoline which enters the torch.



3. Light the gasoline in the cup, after placing the torch in a place in which the air is quiet and does not blow the yellow flame from the torch. The torch should gradually heat up from this operation, and be hot enough to vaporize the gasoline as it comes from the needle valve.



4. Before the yellow flame dies out, open the needle valve in the torch slightly, and permit the gasoline spray in the burner to take fire. As the yellow flame from the cup dies out, the burner flame should become blue or bluish-green, and burn with considerable force. If after the yellow flame is out, the torch is not hot enough for a good, blue flame, hold the burning torch against a cement floor or iron surface until the burner is heated.



Questions:

1. *Why should the torch not be entirely filled with gasoline?*
2. *What is the purpose of pre-heating the burner?*
3. *Why does the gasoline burn with a blue flame in the burner, and with a yellow flame in the cup under the burner?*
4. *What is the advantage of a blue flame in soldering?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

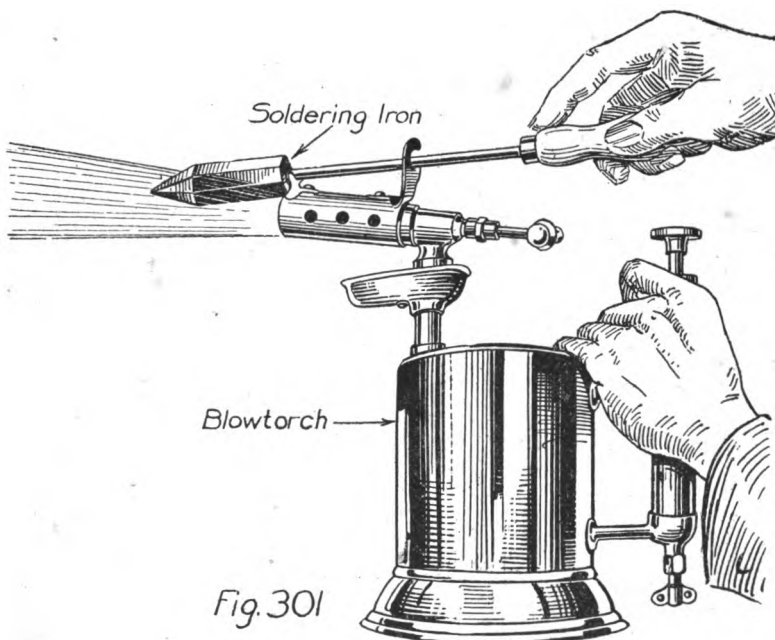
Tinning a soldering iron

References:

Sharp, "Practical Electric Wiring," p. 25.

Directions:

1. Heat the iron in a furnace or blue flame of a gasoline blow-torch until the iron becomes hot enough to melt solder. If the temperature of the iron is increased beyond this point, the flame heating the iron will turn green from the burning copper. This condition should be avoided because at this temperature solder will be burned and will not flow over the iron.



2. With the iron at the correct temperature of melting solder, clean the scale and burned solder from the four sides of the point with sand-paper or a file. Clean the surfaces until the bright copper of the soldering iron shows plainly.

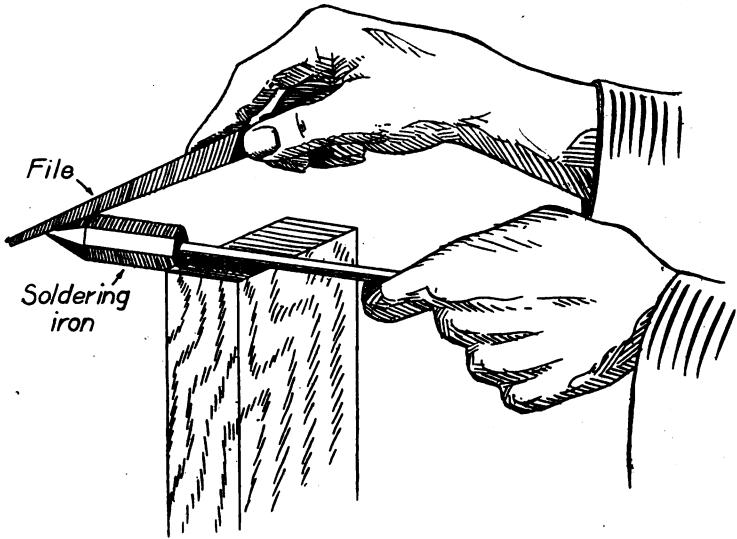


Fig.302

3. While the soldering iron is still hot and the surfaces are clean, apply a soldering flux to the iron, either by dipping the iron into the flux, or wiping a little flux on the iron with a stick.

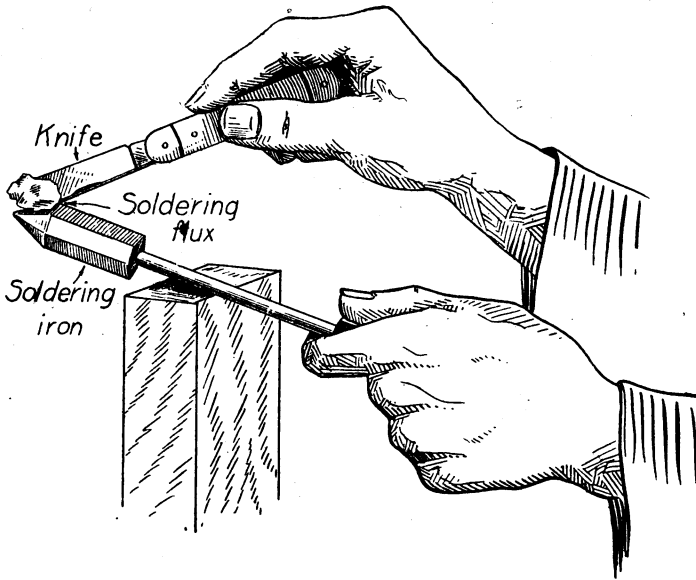


Fig. 303

4. Touch the fluxed surface of the soldering iron with solder until the solder flows evenly over the surface. Wipe the surface with a clean, dry cloth, and see if the entire surface is covered with a smooth even coating of clean solder. If not, apply a little flux and solder at the dull spots and repeat as above. It is not necessary to tin the iron each time it is used unless the surfaces are burned and dirty.

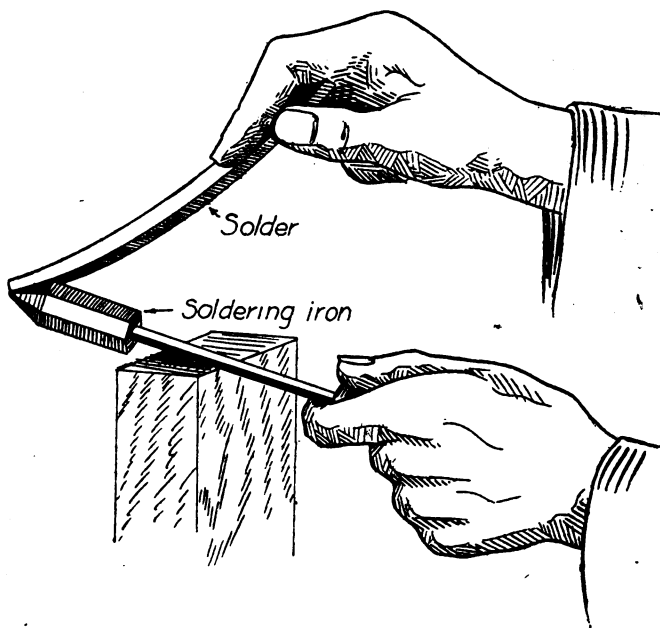


Fig. 304

Questions :

1. *Why is the iron heated before it is cleaned?*
2. *Of what material is the soldering iron made? Why?*
3. *What is the advantage of an electric soldering iron? The disadvantage?*
4. *What is the harm of too much flux on the joint to be soldered?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Soldering joints

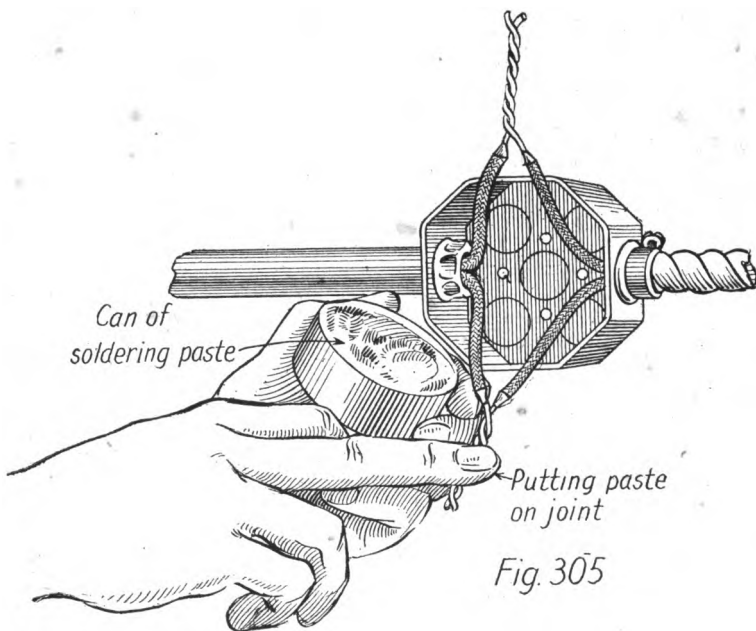
References:

Sharp, "Practical Electric Wiring," p. 23.

Croft, "American Electricians Handbook," p. 102.

Directions:

1. After the joint has been made, and the conductors scraped to make a clean, bright surface, apply a soldering flux. A specially prepared flux can be used, or if none is available, rosin will do if not used in too great an amount.



2. The joint should be carefully heated, taking care not to burn the insulation around the conductor, either by direct action of the flame from the torch, or by overheating the conductors themselves. After the flux has burned off, apply a solder stick until solder begins to flow. Finish the joint by flowing on a little more solder, and wiping off the excess.

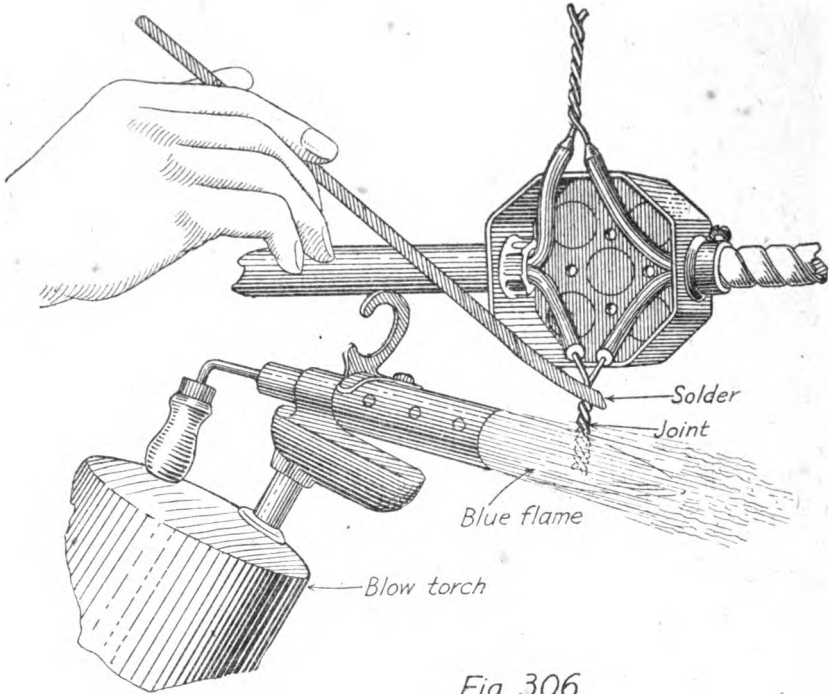
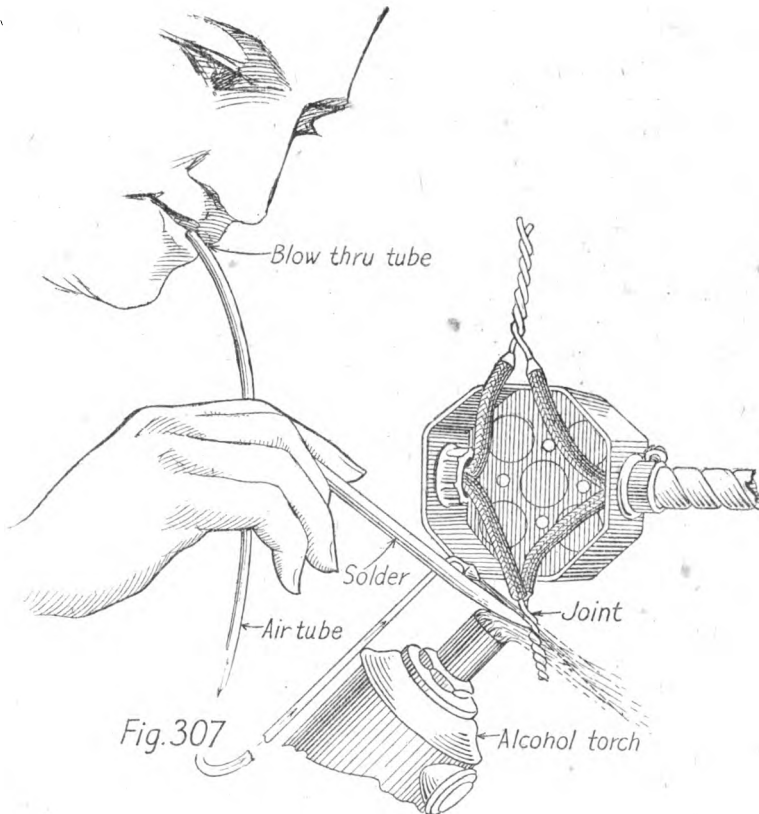


Fig. 306

3. In places, such as fixtures, where a big flame cannot be used, or when the conductors are not too heavy, use an alcohol torch. Blow the blue flame of the torch against the joint until the flux is burned off, apply the solder, and wipe off excess as outlined above. The same care must be exercised about burning the insulation as with the gasoline torch.



4. For such work as will not permit an open flame, use a soldering iron, properly heated and tinned. Hold the tinned surface of the iron under the wire, touch the iron with a solder stick until a ball of melted solder is formed and allowed to touch the wire. As the wire is heated, the ball of solder should flow around the joint. If not, add more solder until the joint is well covered with melted solder. Remove any excess solder, as before.

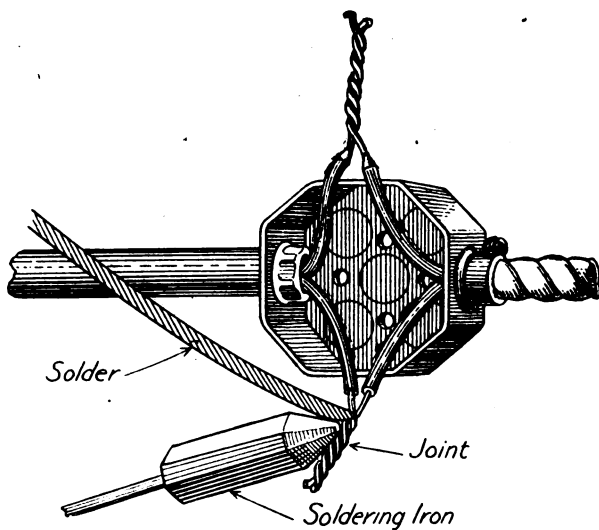


Fig. 308

Questions:

1. *For what kinds of soldering is the blow-torch best? The alcohol torch? The soldering iron?*
2. *In handling the soldering iron, why is the ball of solder on the iron necessary for conducting heat to the wire?*
3. *What is the purpose of the flux? What are the various kinds?*
4. *Why is it not possible to solder aluminum wires by the usual methods?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Soldering lugs

References:

Sharp, "Practical Electric Wiring," p. 26.

Directions:

1. Put soldering flux into the hole in the lug which will receive the conductor. If the lug is of the crimped variety and is not absolutely tight, hold the lug in such a position that the flux will not run out.

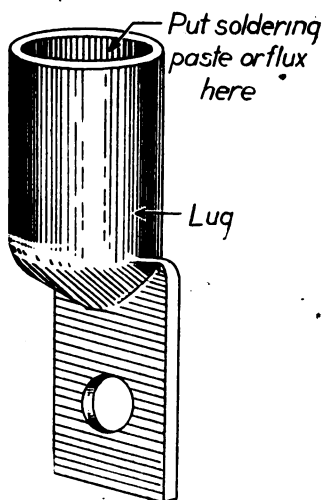


Fig. 309

2. If the conductor is very large, heat the bared part with an iron or in the flame of a blow-torch, applying a little flux while heating. After the conductor is heated, tin its surface and if stranded, flow the spaces between conductors full of solder. Be careful about burning the adjoining insulation.

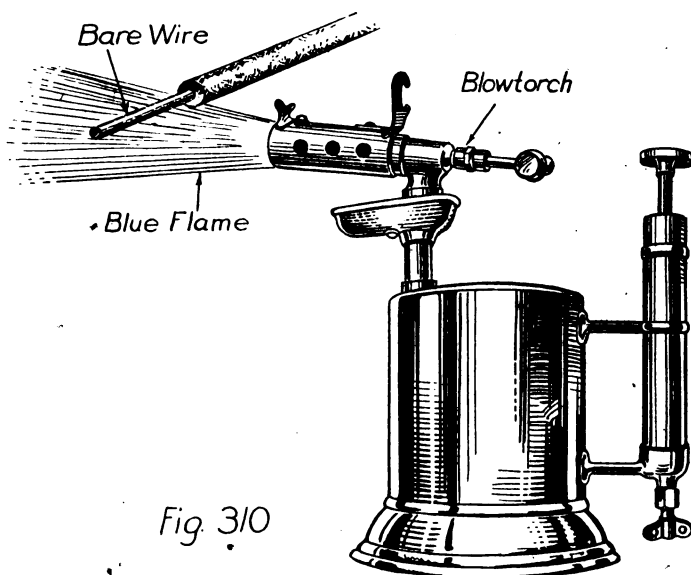


Fig. 310

3. Heat the lug in a blow-torch flame or with an iron, and as soon as the flux is burned out, fill the lug full of solder. Do not allow the solder to flow around the outside of the lug, since the removal of the solder later is a slow and difficult job.

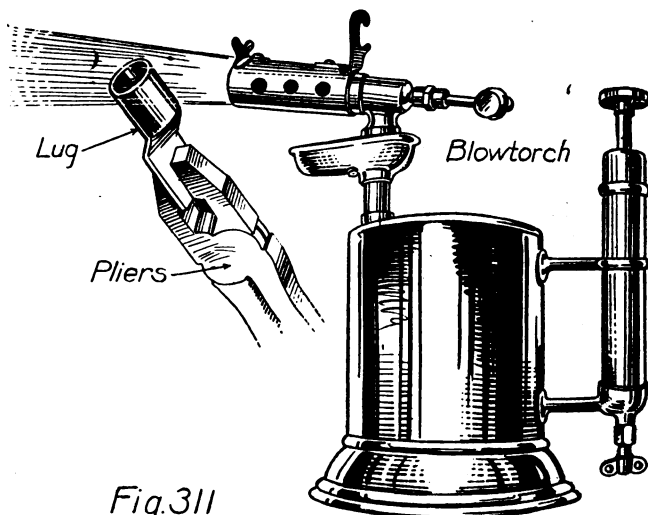


Fig. 311

4. Insert the conductor into the lug filled with melted solder. If the conductor is large, keep it heated until inserted in the lug. If the job of soldering is uncertain, heat the lug

with conductor in it until the solder is again melted in the lug. Hold the conductor and lug still until the solder sets. Try the job by pulling upon lug to see if it is loose.

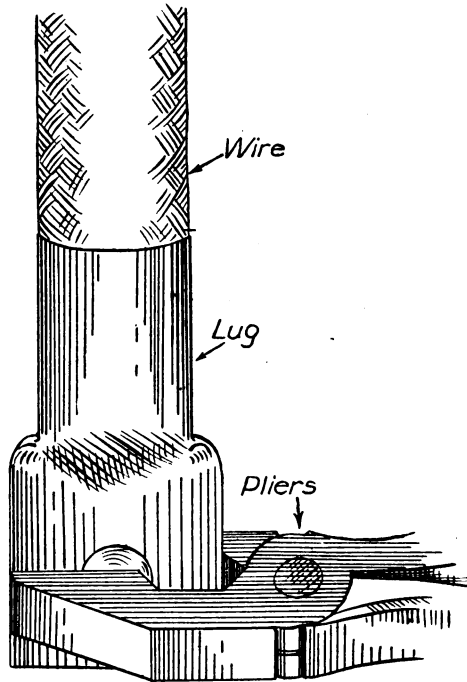


Fig 312

Questions:

1. *What is the purpose of tinning the conductor before inserting in lug?*
2. *What is the purpose of heating large conductors before inserting in lug?*
3. *What is the objection to too much flux in the lug?*
4. *Why is the blow-torch method preferable to the iron method? What are the dangers of the blow-torch method? Of the iron method?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Taping joints

References:

Sharp, "Practical Electric Wiring," p. 27.

Croft, "American Electrician's Handbook," p. 93.

Directions:

1. Apply a first layer of rubber tape, starting the layer by folding the end of the tape under the first turn at the Y of the joint. The rubber must start with the insulation of the conductors.

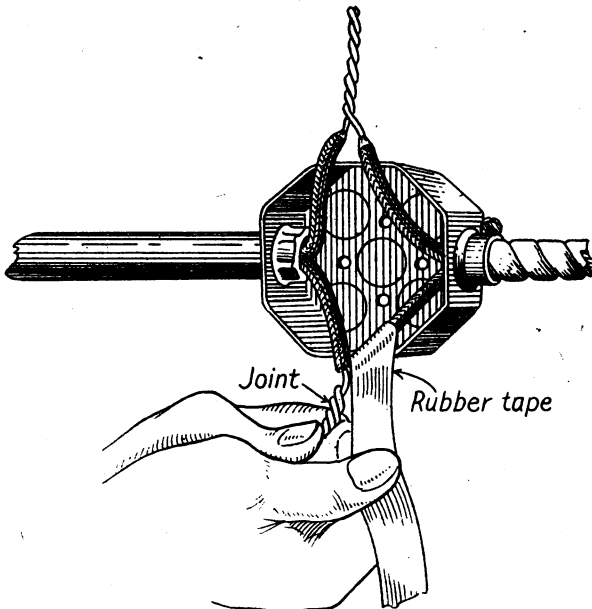
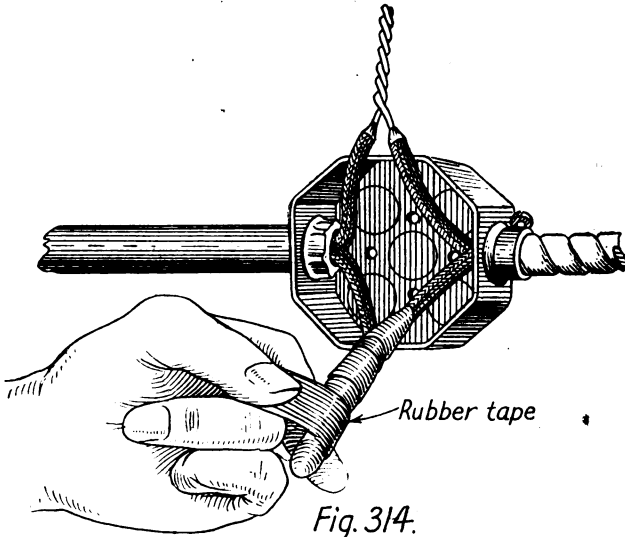
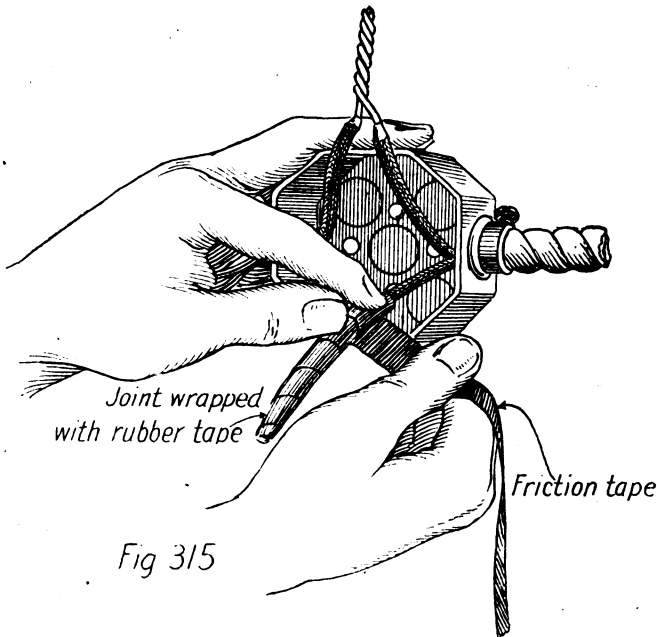


Fig. 313

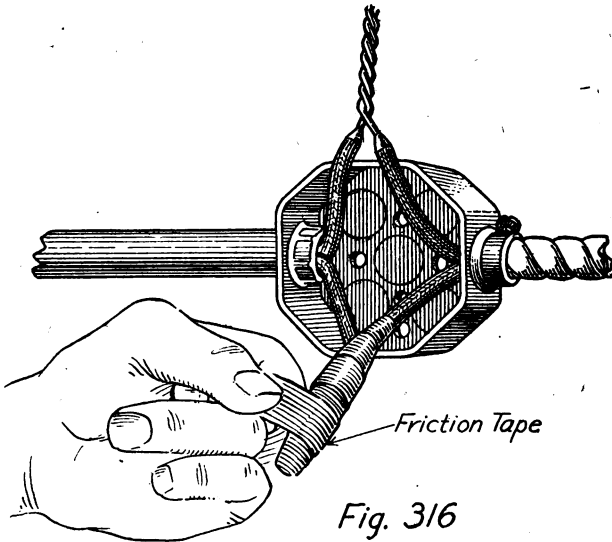
2. Spiral the rubber insulating tape down the joint, pulling it rather tightly, but not enough to break. Make each spiral overlap the previous spiral by about one-half the width of the tape. The layer of rubber tape should be about one-half the total thickness of the insulation on the conductors.



3. Apply a second layer of friction tape over the rubber tape, beginning the layer as with the rubber tape by folding the end of the tape under the first turn. This layer must be pulled tightly, and begin with the insulation of the conductors.



4. Spiral the friction insulating tape down the joint, maintaining quite a pull and causing an overlap of one-half to two-thirds the width of the tape. The friction tape should be spiraled back and forth until the combined thickness of the rubber and the friction tapes is slightly greater than the thickness of the insulation of the conductor.



Questions:

1. What is the purpose of the rubber insulating tape?
2. What is the method of quickly testing rubber tape to see if it is too old to use? What is the test for friction insulating tape?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Removing floor boards

References:

Croft, "Wiring of Finished Buildings," p. 159.

Sharp, "Practical Electric Wiring," p. 109.

Nelson, "Interior Electric Wiring and Estimating," p. 66.

Directions:

1. Locate the position of a pocket to be made in the floor as near to a wall as possible. Avoid a pocket in the center of the floor, whenever possible. Remove the quarter-round strip with two chisels, or with a screw-driver and a chisel, bringing the strip up at an angle with the floor so that the nails in the strip will pull out easily without breaking the strip.

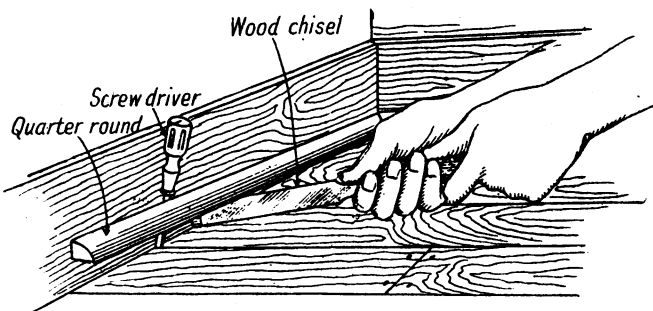


Fig. 317

2. Break the tongue and under side of groove of matched flooring with a sharp, thin chisel, held at a slight angle to save the top side of the groove. Care must be taken not to mar or dent the flooring. Move the chisel along the strip to be lifted, breaking the tongue and groove as the chisel is moved. A sharp-edged scraper is sometimes used for the same purpose the tongue being cut by sliding the edge of the scraper along it.

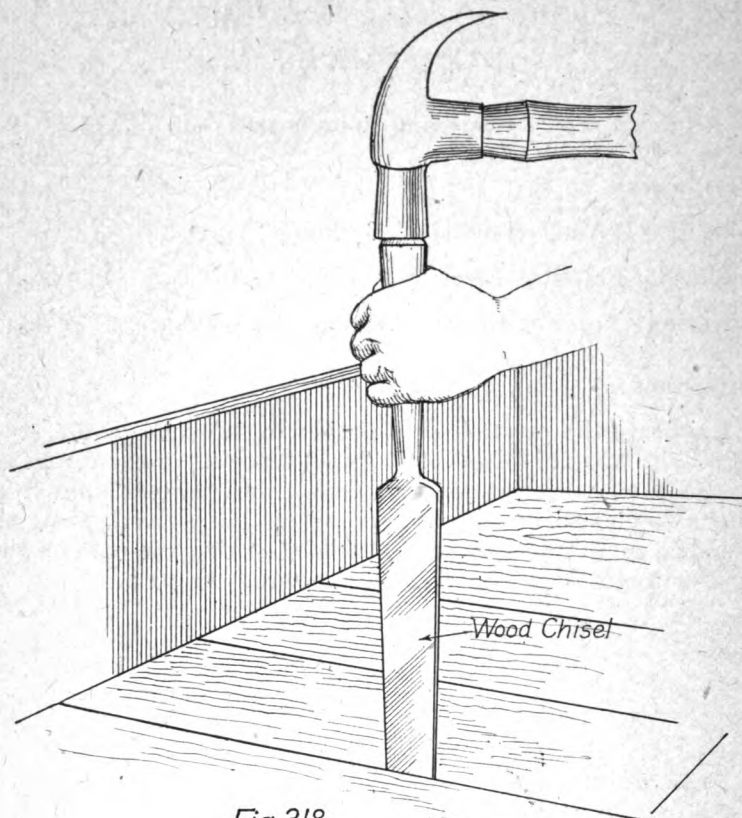


Fig.318

3. If a joint occurs in the flooring above the pocket, lift the board ending at the joint. If no joint in the flooring occurs, drill a small hole through the flooring at one edge of the board or punch a small hole with a chisel. Saw the board across with a fine key-hole saw, and lift as at a joint.

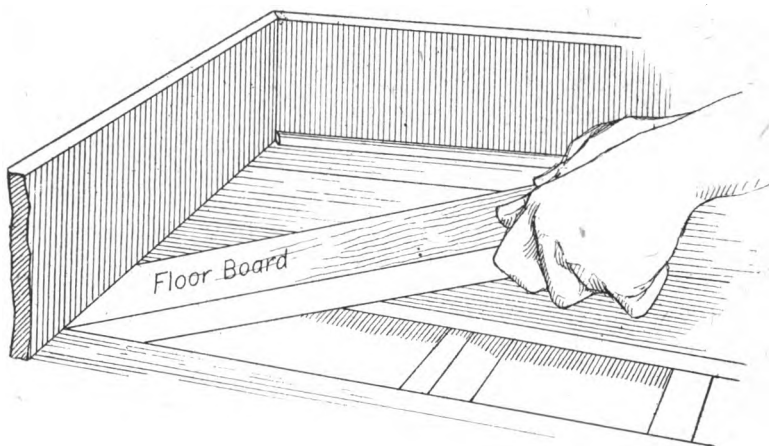
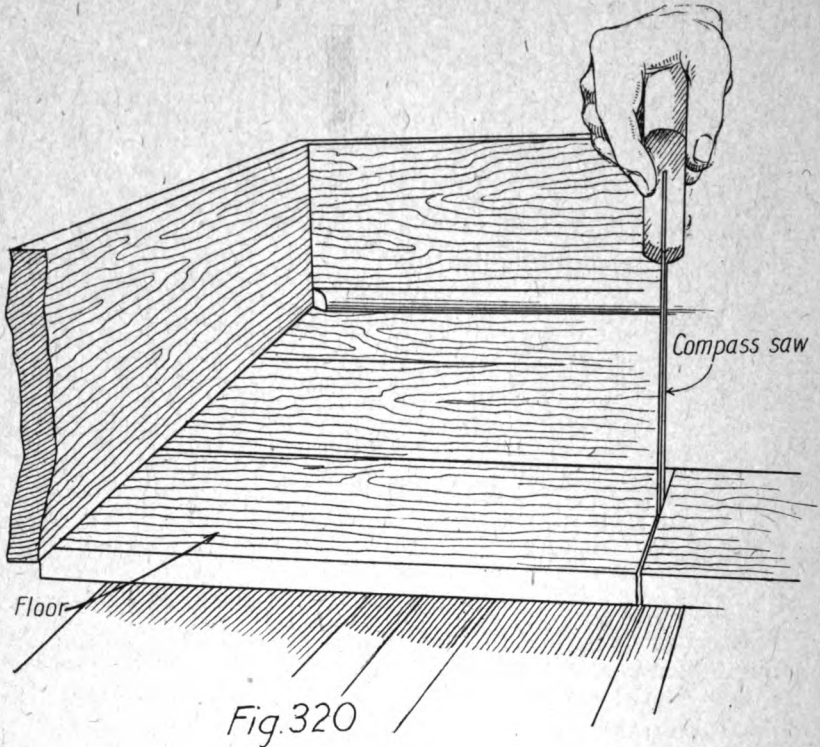


Fig. 319

4. After removing one board, saw along a joist, cutting as many boards as is needed for the pocket. Keep the saw close to the face of the joist while sawing. For good work, lift the first board at a joint in the flooring without making a hole in the floor for the saw, and then saw across the flooring from the joint.



Questions:

1. How are the positions of the joists located before cutting the floor?
2. What is the best method of handling double flooring?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Replacing floor boards

References:

Sharp, "Practical Electric Wiring," p. 102.

Croft, "Wiring of Finished Buildings," p. 165.

Directions:

1. Nail a cleat level with the top of the joist and at the point where the floor boards were sawed off. The cleat must be made as heavy and substantial as possible to prevent a possible collapse of the flooring which is replaced. The cleat must also be so fastened as to prevent creaking of the flooring when finished.

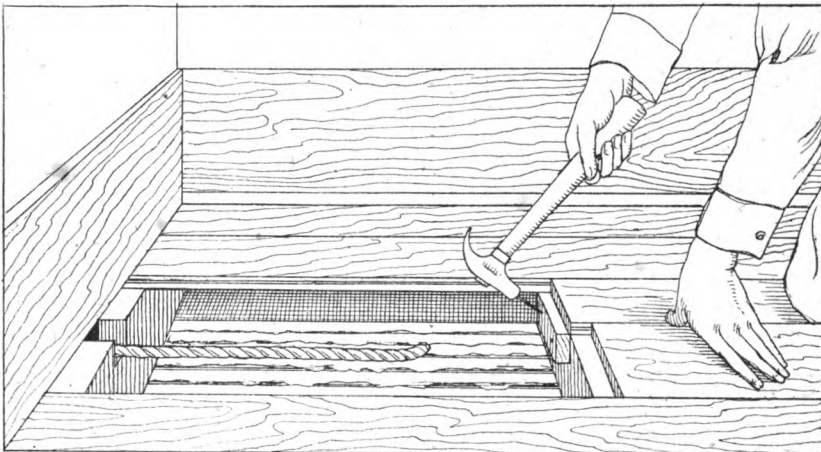


Fig. 321

2. To make a smooth joint when replacing the flooring, plane the tongue if necessary. Do not plane the edge of the flooring since that will make the strips too narrow for the space from which they were removed.

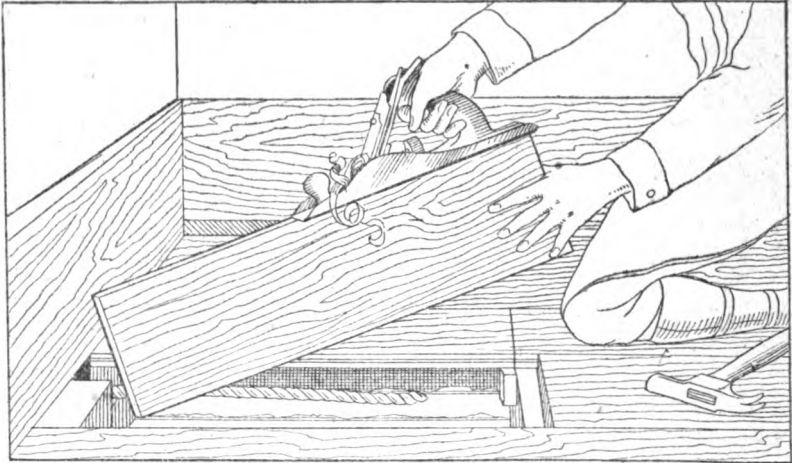


Fig. 322

3. Replace the flooring which was sawed for removal, making the joint at the sawed edge as tight as possible. A little looseness under the quarter-round strip is not objectionable and can be covered. Use finishing nails to hold the flooring in place, securing the flooring to the cleat beneath to prevent rocking.

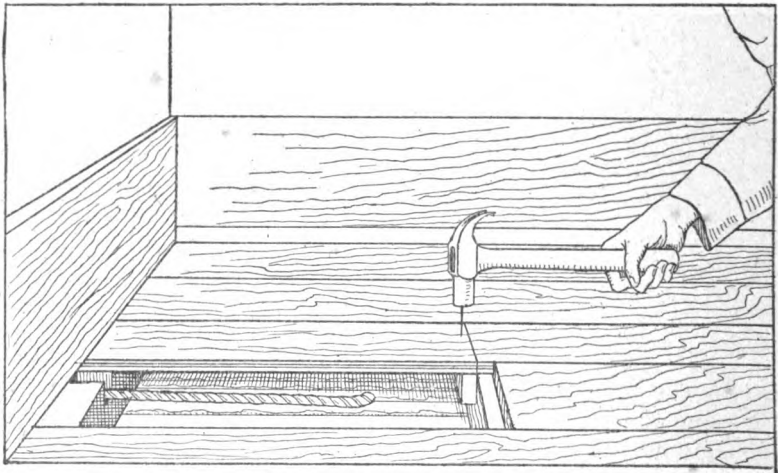


Fig. 323

4. Replace the first board removed when the pocket was opened, securing it with finishing nails, as was done with the other flooring boards.

Replace the quarter-round strip, after cutting off the nails on the back of the strip. Do not try to push the nails through the strip, since the heads will chip the surface of the quarter-round and damage it considerably. The same is true of nails in the flooring.

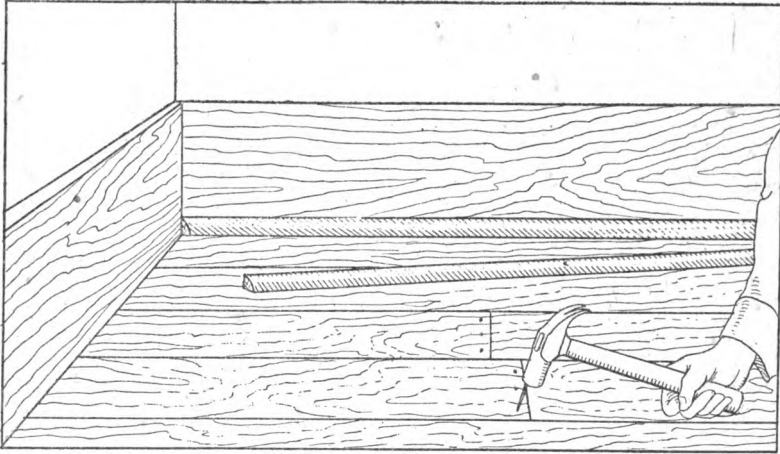


Fig. 324

Questions:

1. *What is the method of taking up flooring for cross-joint wiring?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Removing and replacing trim

References:

Croft, "Wiring of Finished Buildings," p. 168.

Directions:

1. Remove baseboard, door stops, or other trim by starting a wide wood chisel under the edge of the trim, driving the chisel a short distance at several points along the trim. Great care must be taken not to break the plaster or mar the wood work behind the trim.

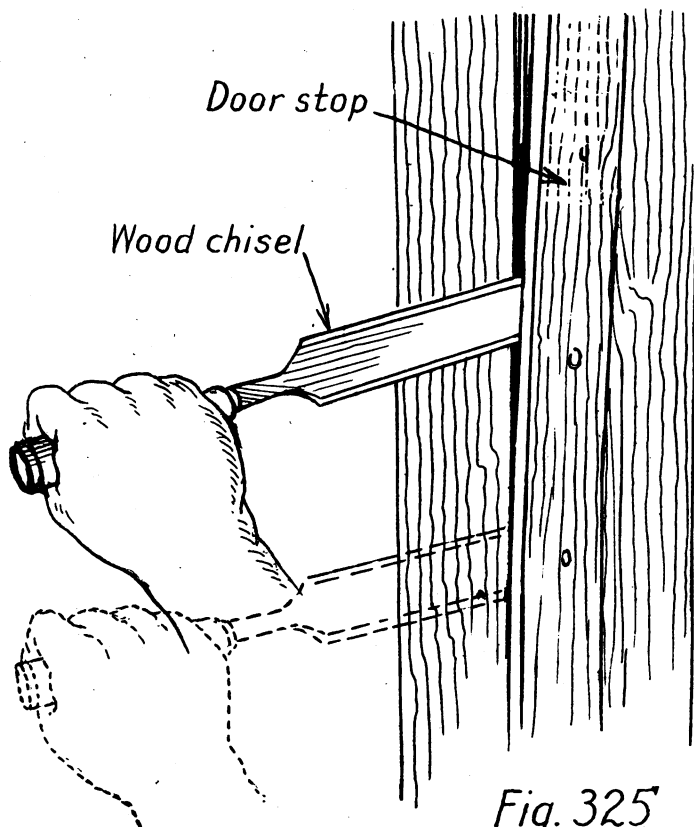


Fig. 325

2. After the trim has been started with the chisel, remove it by prying under one end or edge with a hammer handle or chisel, keeping the nails as straight as possible to avoid wedging or tearing of the trim.

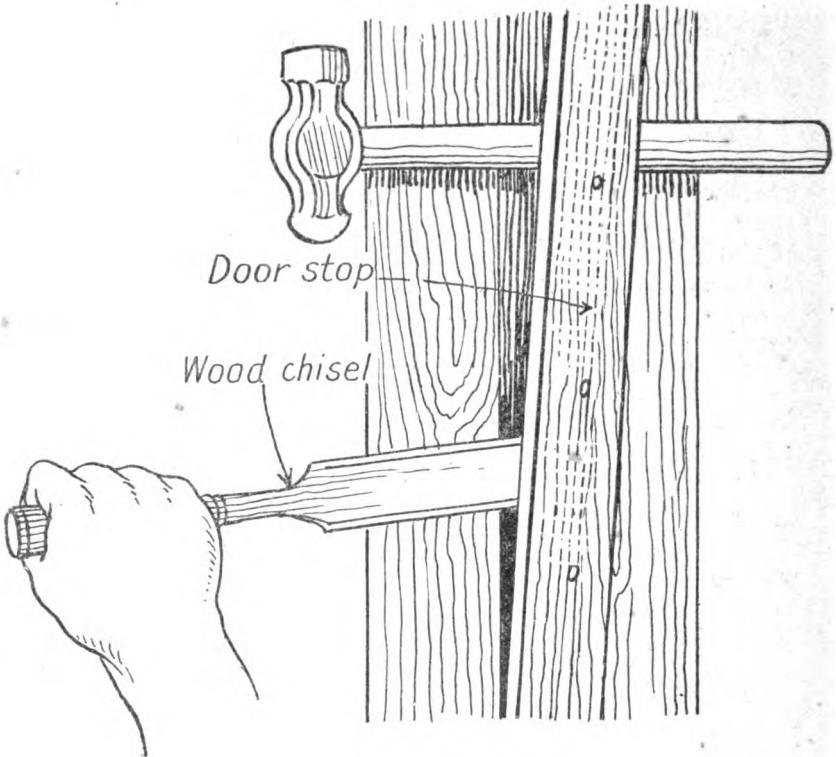


Fig. 326

3. Do not drive the nails through the front of the trim, but cut off with pliers or nippers.

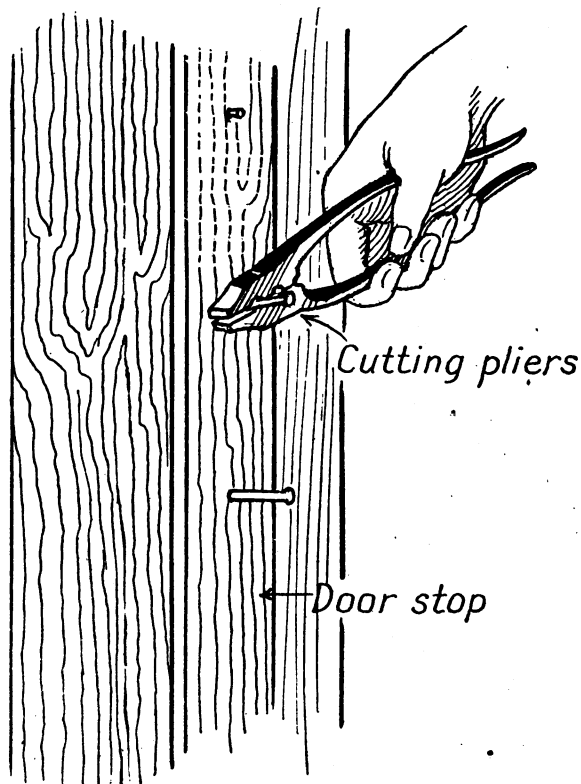


Fig. 327

4. Replace the trim, using new, straight nails, driven in new places. Set the heads of the nails with a small nail set, and fill the holes with putty, darkened to match the surrounding woodwork.

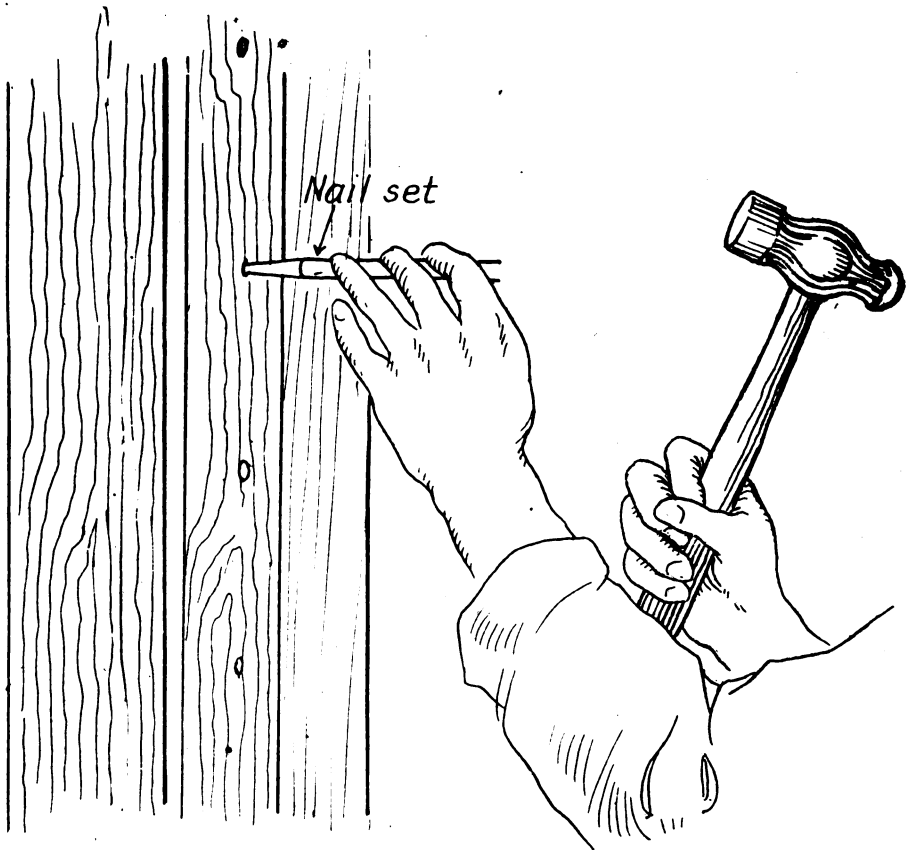


Fig. 328

Questions:

1. *Why is it not advisable to drive nails out of trim?*
2. *Why is it not advisable to remove old nails and place new nails in the holes left by the old nails?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Cutting wall paper

References:

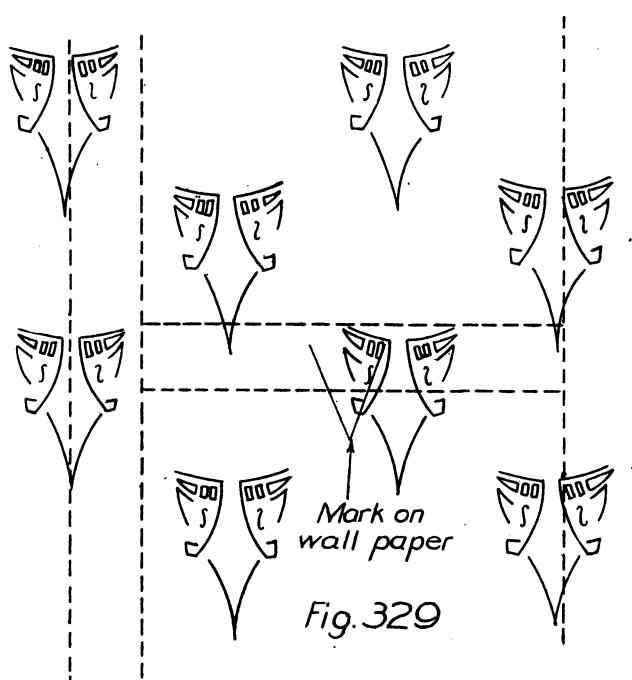
Nelson, "Interior Electric Wiring and Estimating," p. 82.

Sharp, "Practical Electric Wiring," p. 131.

Croft, "Wiring of Finished Buildings," p. 204.

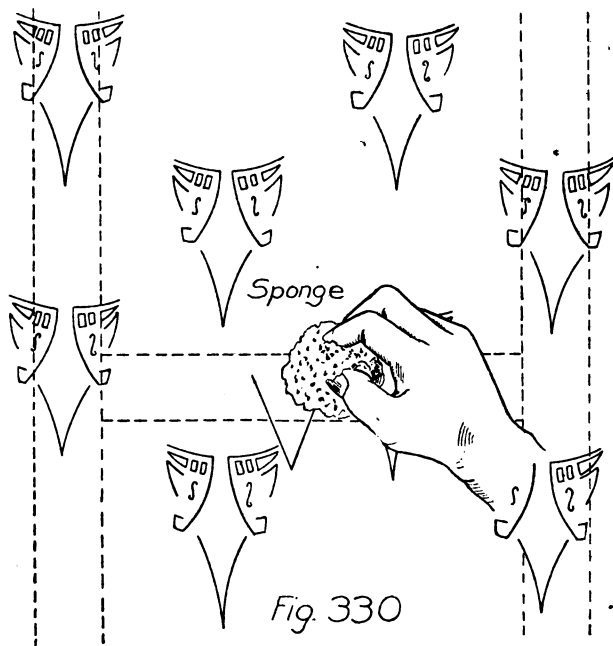
Directions:

1. Determine position of temporary hole to be made in plastered wall. Cut a cross or a V in the paper, with a sharp knife, bringing the center of the cross in the center of the opening to be made.

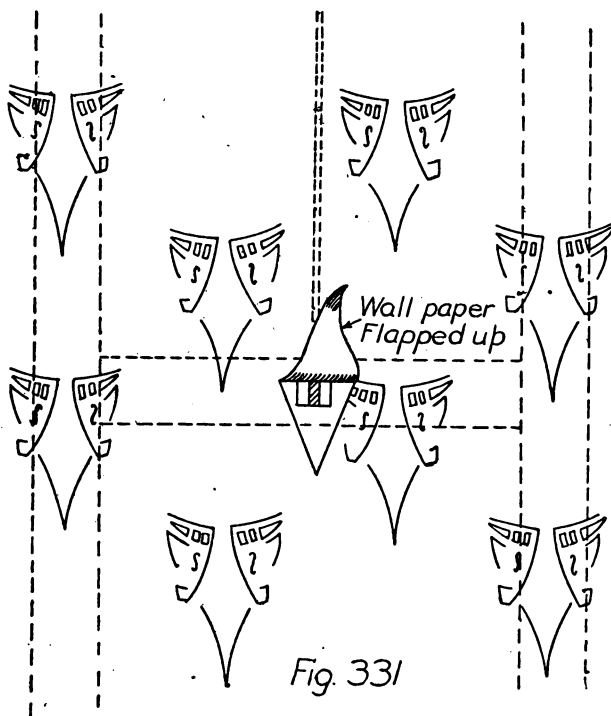


2. Make a test on the same wall paper in some unnoticed corner of the room by wetting the paper to see if the paper can be moistened without danger of causing the colors to run.

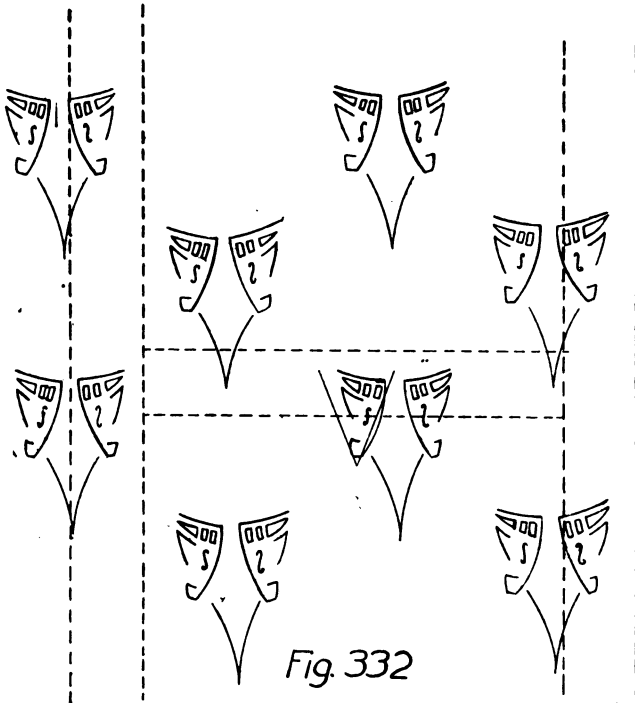
If the colors are fast, wet the paper carefully around the cross cut in the paper, until the paste softens under the paper. If the colors are not fast, the paper should not be disturbed, or a sample of new paper should be obtained to cover the hole.



3. Roll the paper back carefully with a putty knife or similar tool, being careful not to crack or tear the paper. If several layers of paper are found, each layer is lifted in the same manner in succession.



4. After job is completed in wall, and the hole is filled with plaster of Paris to the level of the surrounding wall, replace each layer of paper carefully, using flour paste or mucilage. If replaced carefully, the opening is hardly noticeable.



Questions:

1. *When is it necessary to cut wall paper for temporary openings?*
2. *How are damages repaired in painted or calsomined walls?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

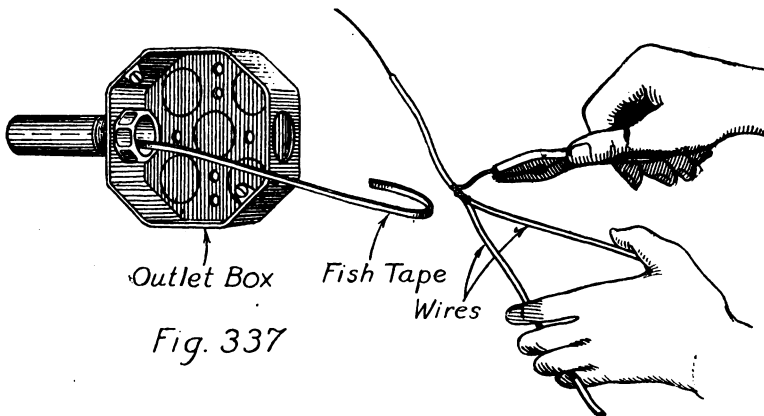
Pulling conductors into conduit

References:

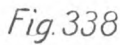
- Cook, "Interior Wiring," p. 222.
Croft, "American Electrician's Handbook," p. 507.
Sharp, "Practical Electric Wiring," p. 120.

Directions:

1. Remove the insulation from both conductors to a distance of about four inches. Attach one conductor to the other about six or eight inches from the end of the leading conductor. The bare conductor must be tightly twisted around the insulation of the leading conductor to prevent slippage under strain.



2. The bare conductor of the leading wire must be twisted carefully around the hook of the fish-tape or through the loop of a fish-wire. Care must be taken not to kink or cut the conductor during the process.



A detailed line drawing illustrating the use of fish tape to pull wires through a cable jacket. On the left, a cross-section of a cable jacket is shown with several circular holes. A hand on the right holds a roll of tape, and another hand pulls the tape through one of the holes. The tape is then used to pull the inner wires through the hole. Labels include 'Tape', 'Wires', and 'Fig. 339'.

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During hot weather, or in heavy pulls, soapstone should be blown into the conduit or rubbed upon the insulation as the conductors enter the conduit.

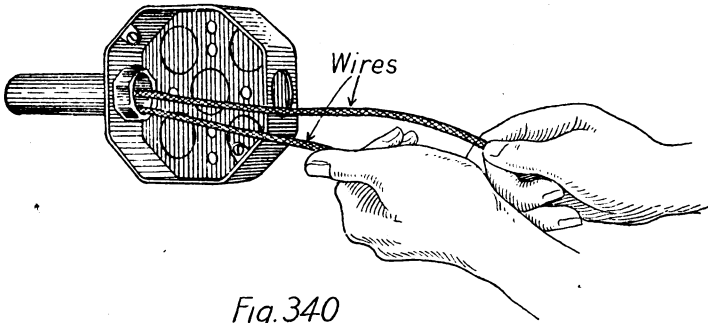


Fig. 340

Questions:

1. *Why is it a mistake to pull-in conductors too tightly in conduit?*
2. *What is the largest solid conductor usually pulled into conduit?*
3. *What is the method of determining if the conduit is large enough for the conductors which are expected to pass through it?*
4. *What is the method of making heavy "pulls" in large conduit systems?*

copper may cause the conductor to break off during the pull, necessitating the removal of all conductors and re-fishing the run.

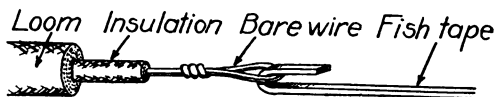


Fig.351

4. Pull the fish-tape from the opposite end of the run, feeding the loom-covered conductors through outlet opening in a way to prevent damage to wall. If necessary, wrap a layer of tape over end of loom and conductor to prevent slipping of loom and catching on lath or plaster in partition.

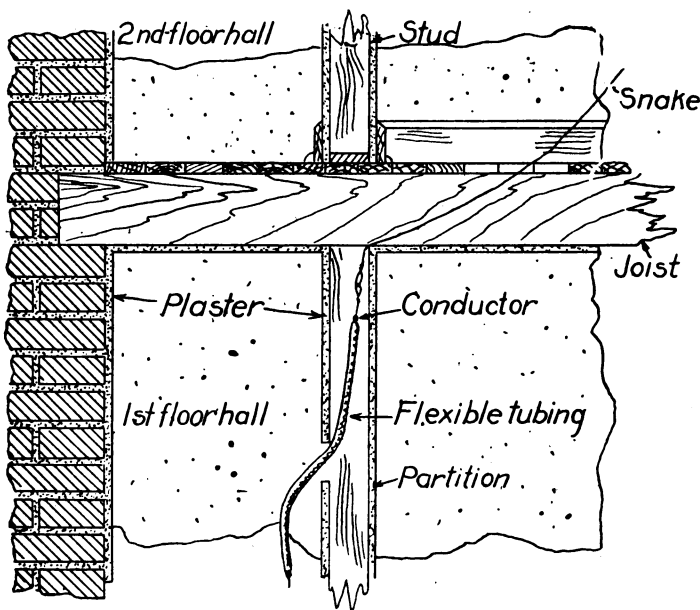


Fig.352

Questions:

1. Why is it unsafe to fish extremely long runs of loom-covered conductor?
2. Why is it not permissible to use duplex or twin wire in loom?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Fishing loom-covered conductor

References:

Croft, "Wiring for Light and Power," p. 258.

Croft, "Wiring of Finished Buildings," p. 123.

Directions:

1. Measure a sufficient length of conductor to make the run from outlet to outlet. Run the conductor through a length of loom or flexible tubing of sufficient length to extend six or eight inches beyond each outlet.

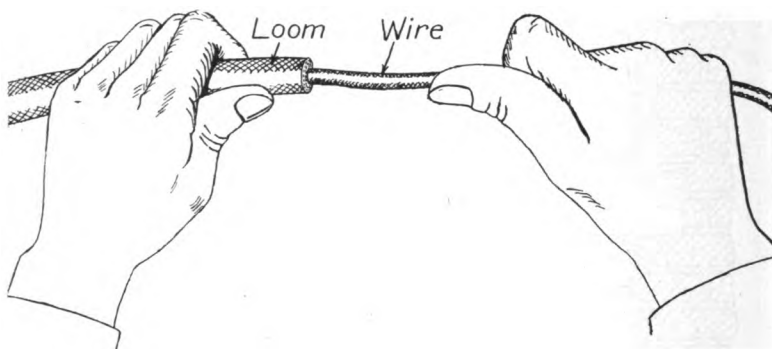


Fig. 349

2. Remove the insulation from the conductor or conductors to be fished, baring a length of five or six inches of conductor on each length.

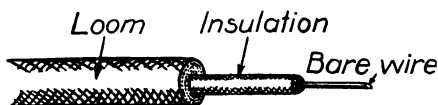


Fig. 350

3. Pass the bared ends of conductors through the loop in the fish-tape, looping the conductors back upon themselves, making a firm loop by twisting the ends of the conductors upon themselves with a pair of pliers. Be careful about nicking or cutting the conductors since a slight damage to the

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Fishing with a "mouse"

References:

Croft, "Wiring of Finished Buildings," p. 184.

Directions:

1. Attach a small weight or chain to a chalk line or other cord. After the partition has been explored for bridges and plates and the run has been determined, cut the opening for the outlet. Drop the "mouse" through the opening into the partition.

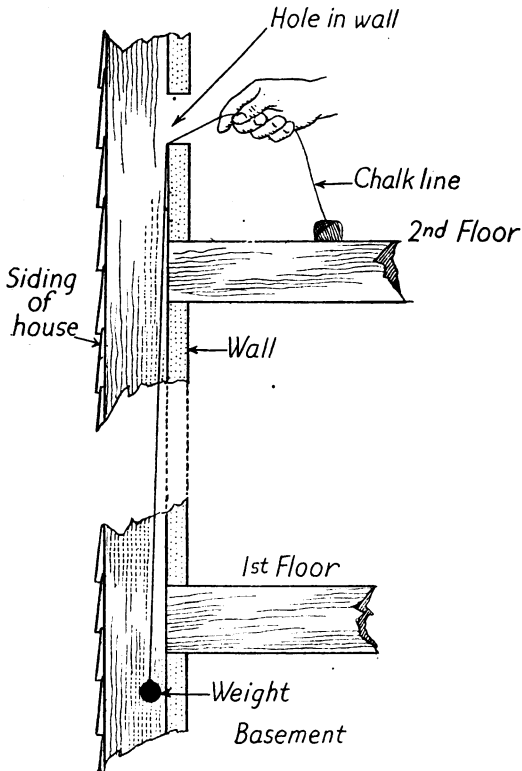
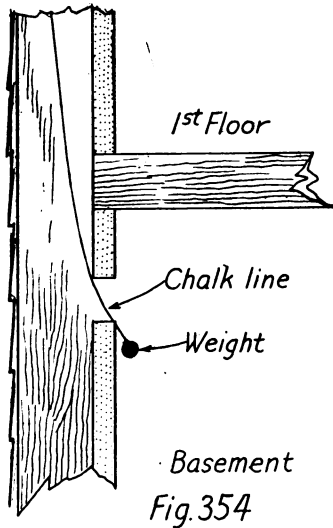
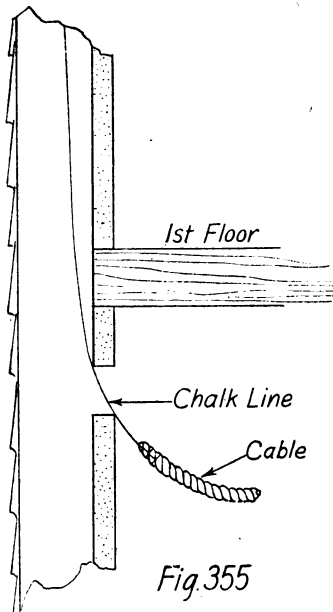


Fig. 353

2. Sound the position of the "mouse" at the lower end of the partition or determine its position by the length of the lower end of the run to be fished, and pull the "mouse" through the opening, taking the chalk line with it.



3. Attach the conductor, conduit, or fish-tape to be fished, to the end of the chalk line.



4. Pull chalk line back through the opening from which it was dropped, bringing the conductor, conduit, or fish-tape with it, completing the run.

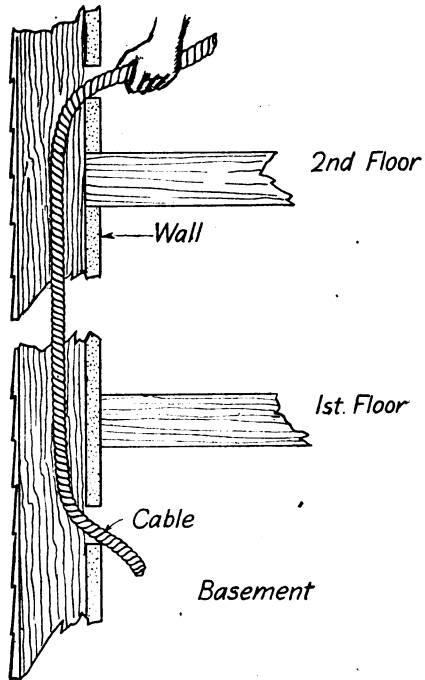


Fig.356

Questions:

1. Is it advisable to fish a run of flexible conduit with the chalk line?
2. Under what conditions can a "mouse" be used for fishing?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Fishing with a "mouse" and looped "snake"

References:

Croft, "Wiring of Finished Buildings," p. 190.

Sengstock, "Electrician's Wiring Manual," p. 355.

Directions:

1. Make a small closed loop in the end of a standard fish-tape. If necessary, wrap a small binding wire around the end of the loop to keep it from opening under stress.

Another method is to fasten a porcelain knob at the end of a piece of stiff wire.

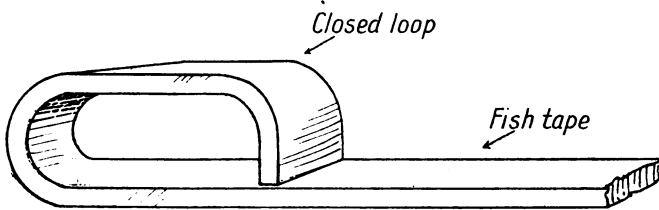


Fig. 361

2. Pass a regular "mouse" through the loop in the fish-tape or "snake" or around the knob at the end of the stiff wire.

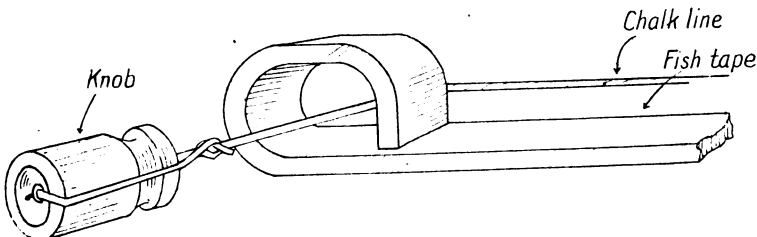


Fig. 362

3. Push the "snake" or stiff wire between the floor and ceiling below, from a pocket cut in the floor, holding the cord of the "mouse" tight, so that the "mouse" will be held tightly against the loop in the "snake."

Push the "snake" until the loop comes over the opening in the partition at the end of the run between the floor and ceiling.

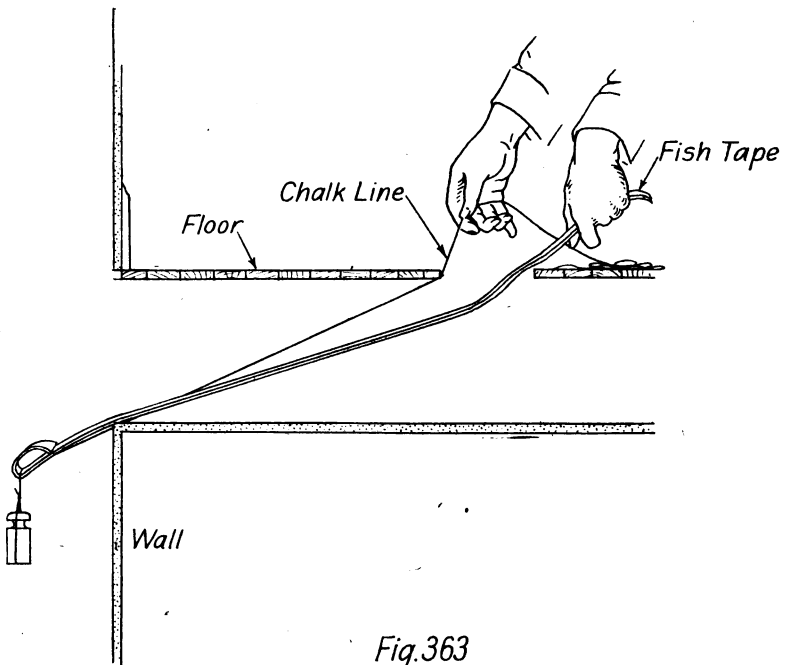


Fig. 363

4. When the loop is over the opening in the partition, release the cord of the "mouse" and let it drop between the walls of the partition. Catch the "mouse" through the hole at the lower end of the partition using a hooked "snake."

Draw the "mouse" through the lower end of the run, and attaching the fishwire, pulling the "mouse" back to the pocket above, carrying the fishwire or tape with it.

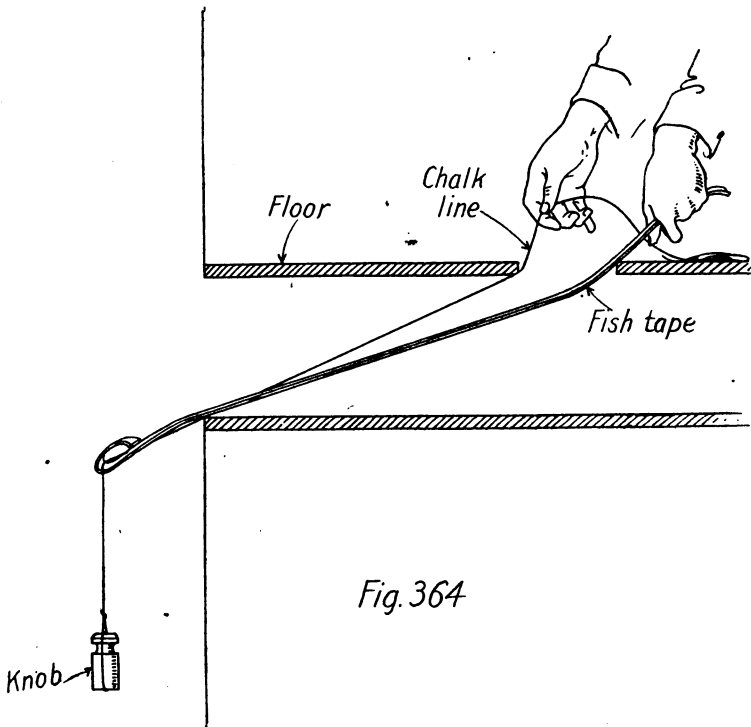


Fig. 364

Questions:

1. What precaution should be taken to prevent the "mouse" from drawing the entire length of line through the loop in the "snake"?
2. Could "mouse" and looped "snake" fishing be used for offset walls?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Exploring with a mirror and lamp

References:

Croft, "Wiring of Finished Buildings," pp. 179-180.

Sharp, "Practical Electric Wiring," p. 160.

Directions:

1. With drop lamp. Attach a miniature lamp socket to a pair of twisted conductors, and illuminate the interior of a partition by dropping the lamp through a pocket or outlet opening. Use dry cells to furnish energy for the lamp.

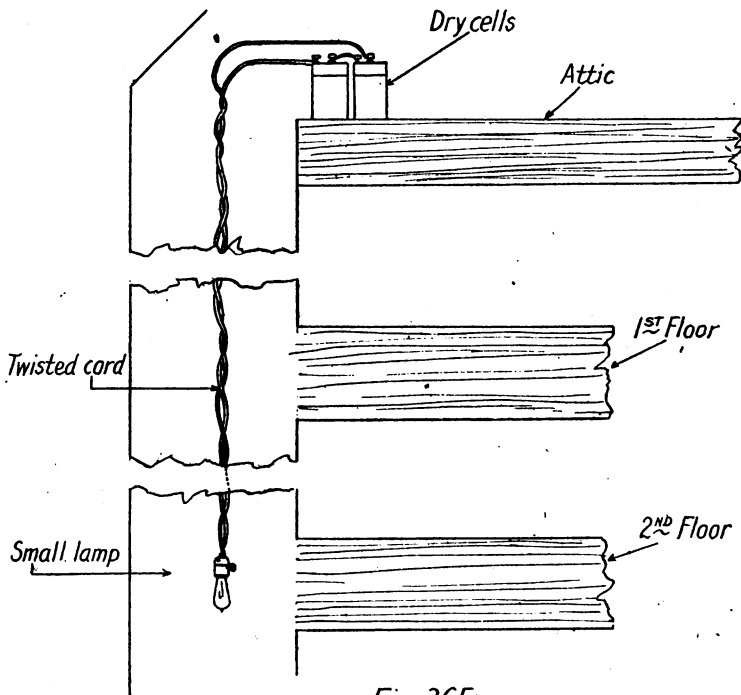


Fig. 365

If opening above is of sufficient size, look into partition for obstructions. If not, look for light through lower end of partition, drilling small holes at lower end of run, or explore partition from above with mirror.

2. With mirror in outlet. Attach a small mirror to a stick. Insert mirror into opening for outlet, slanting it to reflect inside of partition, either upward or downward. Throw the light from a flashlamp against mirror, reflecting the light into the interior of partition. Light will be reflected back from partition to mirror, showing condition of partition.

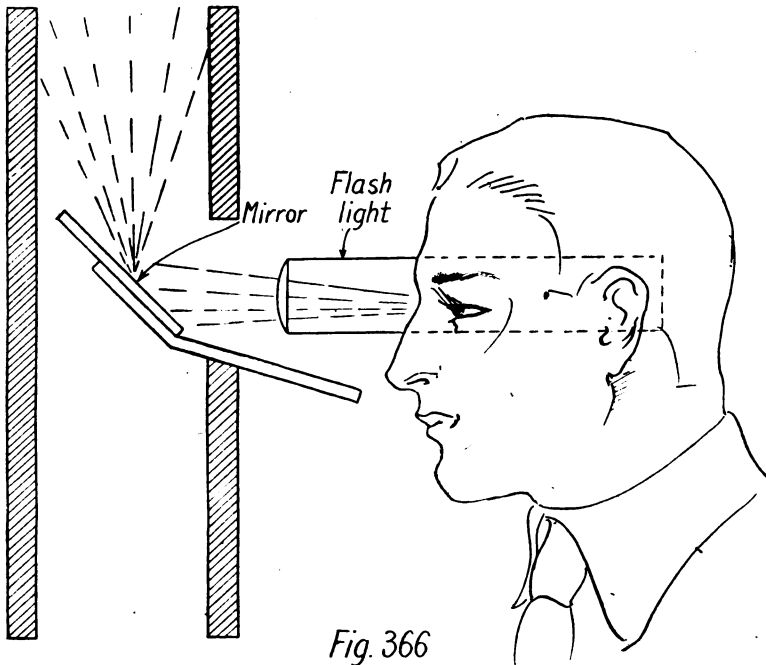


Fig. 366

3. With mirror and one pocket. Open floor with one pocket. Place a mirror at one side of pocket, and illuminate under floor in opposite direction with a flashlamp. Mirror will reflect light from under the floor, showing condition of run.

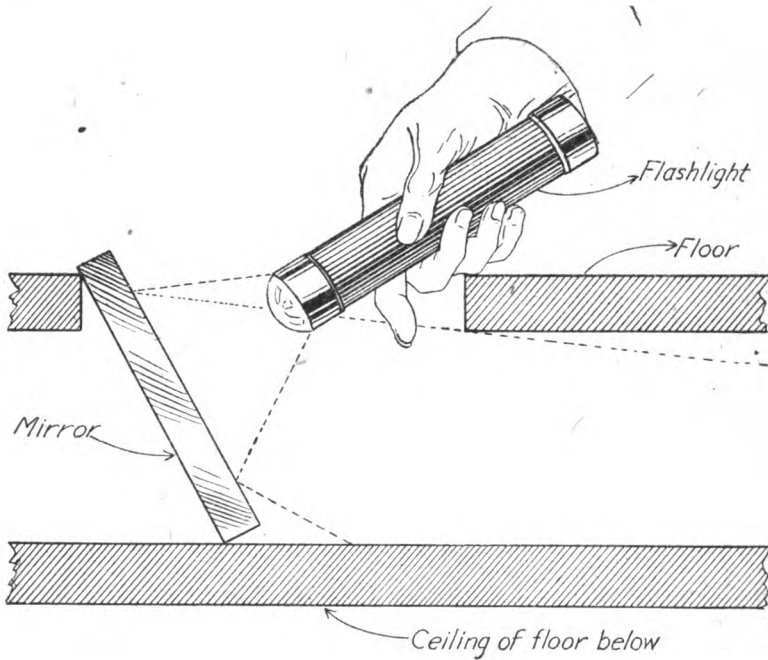


Fig. 367

4. With mirror, lamp and two pockets. Cut a pocket at each end of the run to be fished. Insert a flashlamp or other lamp in one pocket and a mirror in the other. Mirror will reflect light passing from lamp through the run to be fished, and show condition of the run.

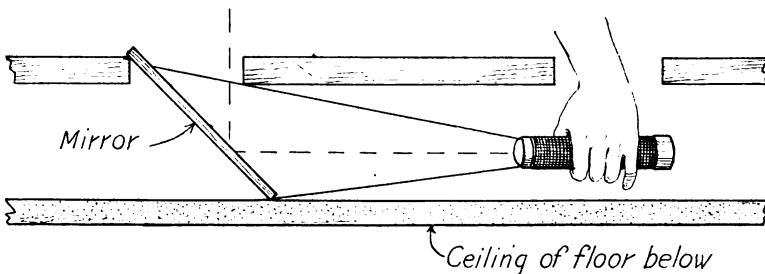


Fig. 368

Questions:

1. Can a candle be used instead of the electric drop lamp?
2. Can the space between joists be explored without a mirror if a lamp is available?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Exploring with a "mouse" or a fish-tape

References:

Croft, "Wiring of Finished Buildings," pp. 184, 187.

Sengstock, "Electrician's Wiring Manual," pp. 357, 359.

Directions:

1. Attach a small weight or a piece of chain to a string or chalk line. Bore a small hole in partition to be explored or use a hole cut in the partition for an outlet. If a new outlet is planned it is best to explore through a small hole in partition before cutting outlet, since obstructions may be such as to warrant a change in the location of the outlet.

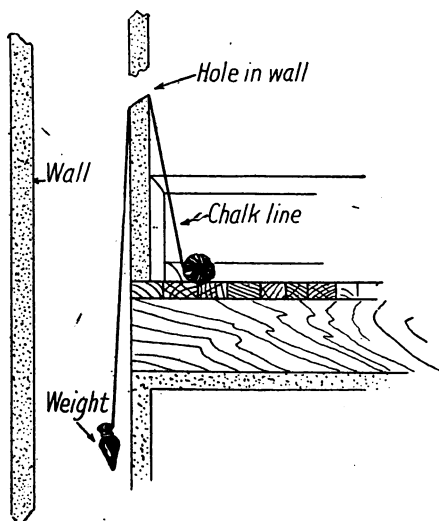


Fig. 369

2. Drop the weight or chain through the hole, and gradually allow weight to pass through the partition. When the weight meets with an obstruction, make a knot in the string at the opening in wall through which the string was dropped, pull the weight back, and measure length of string from the

knot to the weight. Compare with length of partition, and determine whether obstruction is a bridge, plate, or floor below.

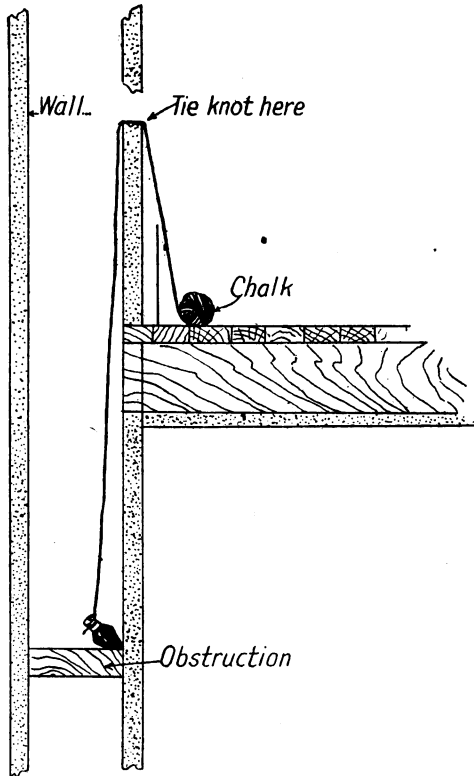


Fig. 370

3. To explore a horizontal run, as between a ceiling and the floor above, use a standard fish-tape. Bend the end of the tape into a loop, or attach a small weight to end of tape, by riveting weight to end of the tape.

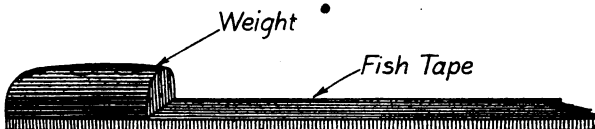


Fig. 371

4. Push the tape through the space to be explored until an obstruction is met. Before making the final stop, try to push the tape beyond the obstruction by whipping the tape, causing the end, very often, to pass a brace or obstruction which stops it. When the end of the run is reached, mark the end of the tape at the outlet through which the tape is inserted, pull the tape out of the run, and measure the length from the end of the tape to the marked point. Compare with length of floor.

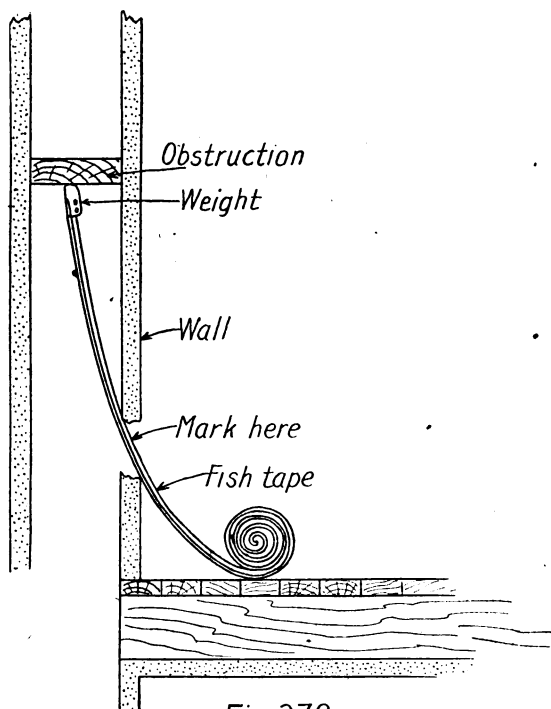


Fig. 372

Questions:

1. Is it possible for a fish-tape or "mouse" to pass an obstruction which cannot be passed by the flexible conduit to be fished later?
2. Can the lower end of the "mouse" be located by sounding, when exploring for bridges or plates?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

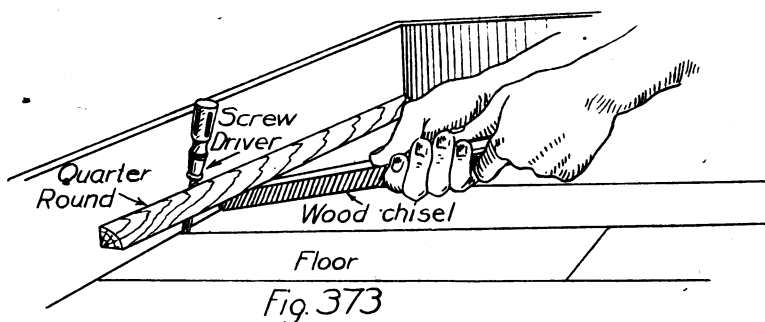
Exploring with a "feeler" bit

References:

Croft, "Wiring of Finished Buildings," pp. 178, 182.

Directions:

1. Remove the quarter-round, baseboard or any easily removable trim near the point to be explored. In most cases it is necessary only to lift the trim enough to insert the bit, thus making it an easy matter to replace the trim without disturbing the nails in the trim.



2. Run a long-shank "feeler" bit diagonally through the floor or wall behind the trim which has been removed, using a small size wood drill. If the hole is being drilled into a basement no particular care is necessary when the drill or bit breaks through the flooring, but when "feeling" from wall to wall in a partition, great care must be used when the drill passes through the second wall.

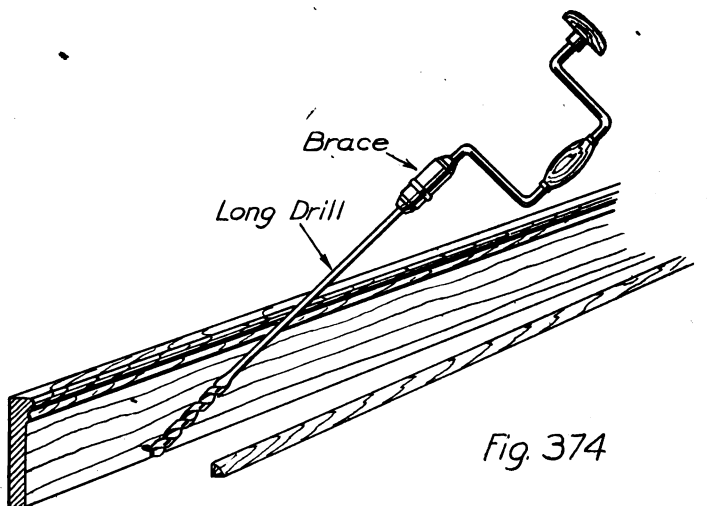


Fig. 374

3. After drill has passed through to a clear space, investigate in basement or other side of partition for appearance of bit or drill. The passage of the bit provides a clear passage for fishing, and it also indicates the location of the drop or hole on both sides of the partition or on floor above and in basement below.

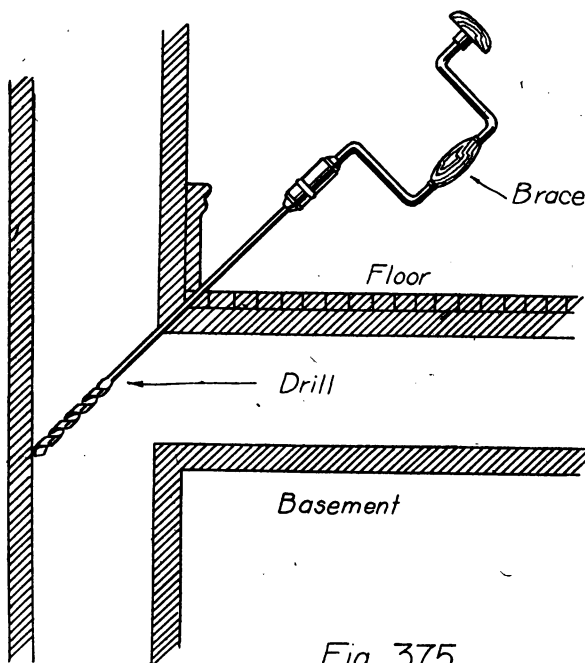
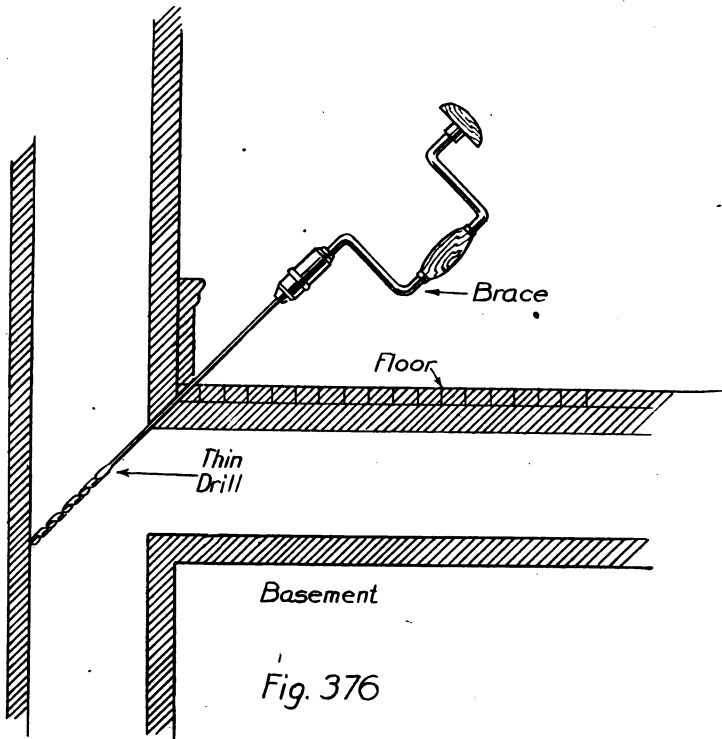


Fig. 375

4. Sometimes very fine holes are drilled with special wire drills leaving holes that are almost invisible after the exploring is completed.



Questions:

1. Can a hole be drilled with a "feeler" bit on upper floors when exploring partitions on lower floors?
2. Can "feeler" bit holes be drilled from ceilings to attics to locate fixture outlets?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Drilling through brick walls

References:

Croft, "Wiring of Finished Buildings," p. 213.

Directions:

1. Cut a length of conduit of the size to be brought through the wall, making the length about one foot larger than the thickness of the wall.

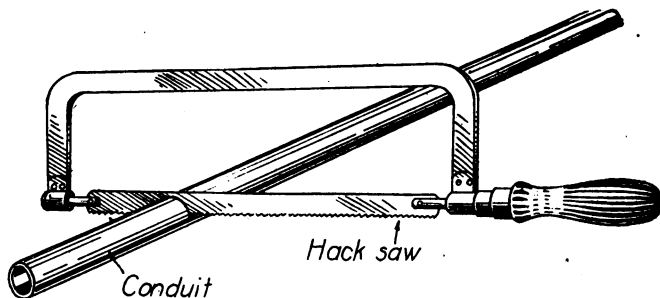


Fig. 377

2. Slanting end drill. Saw the cutting end of the pipe drill at an angle of about 45 degrees.

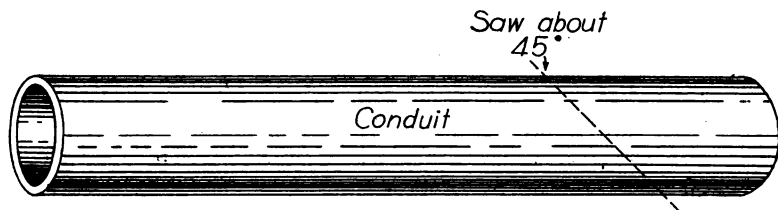


Fig. 378

3. Saw tooth end drill. Saw the end of the pipe drill squarely across, and file a series of notches or saw-teeth in the end of the pipe drill with a triangular file, cutting the teeth as deeply as the file will permit.

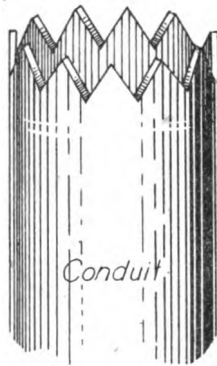


Fig.379

4. Place the end of the pipe drill against the wall at the point where the hole is wanted, and, holding the drill with one hand, pound the opposite end with a hammer, turning the drill a little after each blow. After a few strokes, remove the drill from the wall, shake out the grit and proceed as before. Be careful when breaking through the wall, not to damage the opposite side unnecessarily.

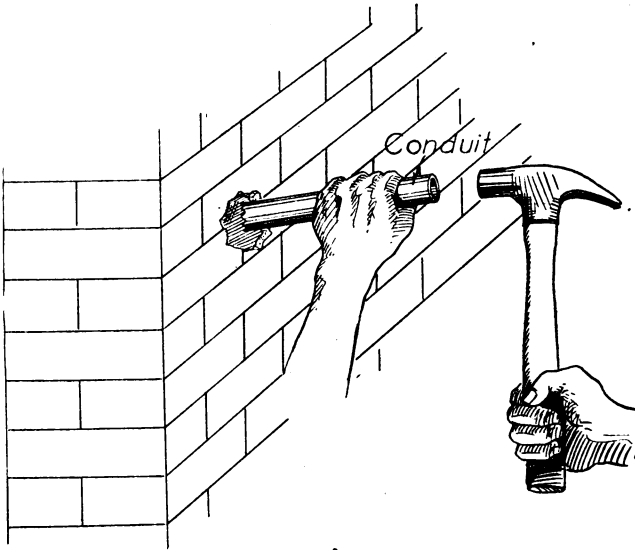


Fig.380

Questions:

1. *What should be done if the burr over the hammered end of the drill becomes curled?*
2. *What precaution must be taken by the wiremen hammering the drill?*
3. *Why is it necessary to turn the drill as it is hammered?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Drilling through plates and bridges

References:

- Nelson, "Interior Electric Wiring and Estimating," p. 81.
Croft, "Wiring of Finished Buildings," pp. 171, 177, 202, 212.

Directions:

1. Through outlet opening. Attach a drill of suitable size to an extension bit holder.

Explore partition from outlet opening with mirror or direct sighting. Extend bit through outlet opening until it strikes bridge or plate, and drill hole, taking care not to break through wall on opposite side of partition, or of losing bit in partition.

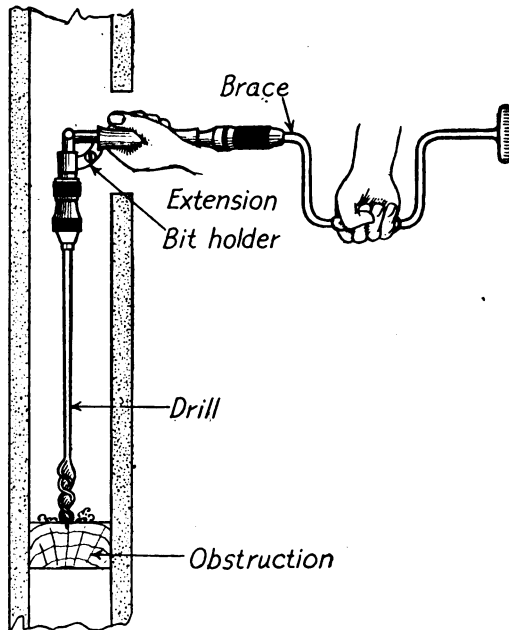


Fig. 381

2. Behind Baseboard. Remove baseboard in room on floor above. Cut away lath and plaster behind baseboard at the floor line, and cut a small hand hole in the two-by-four plate supporting the upper floor studding.

Insert a bit with extension bit holder through hand hole, and drill hole in plate supporting floor joists and resting on studding of lower partition.

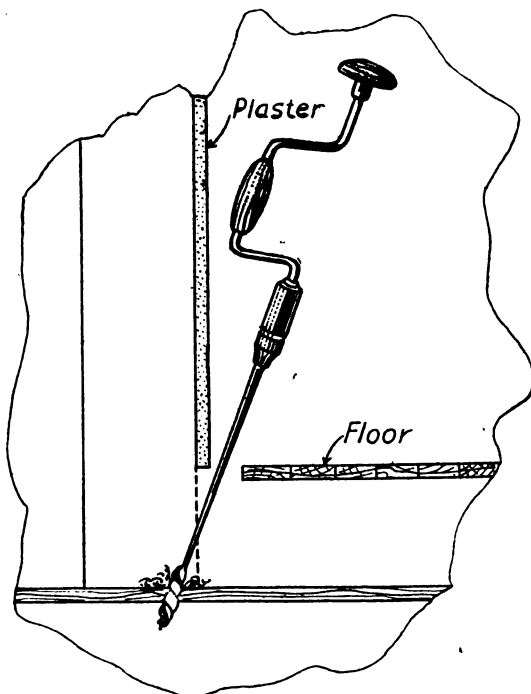


Fig.382

3, With ratchet drill. Remove sufficient flooring at edge of partition to form a small pocket to get under floor plate of partition through which conductors must be fished.

Place a wide board on plaster and lath, if no plate is immediately below the plate to be drilled, and rest feed screw of ratchet drill on board. Insert bit in ratchet drill and drill upwards into plate.

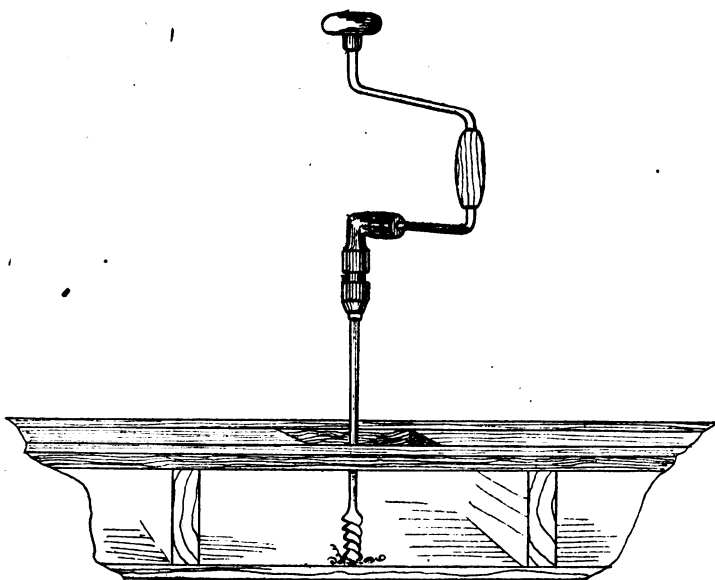


Fig. 383

4. With hand bit. Remove flooring at edge of partition for a pocket, as is done for ratchet drill. Insert a wood bit against plate, turning bit with wrench or pliers. Hold lower end or shank of bit with an old door knob attached to bit, or with anything handy that can be used for pressing the bit against the plate.

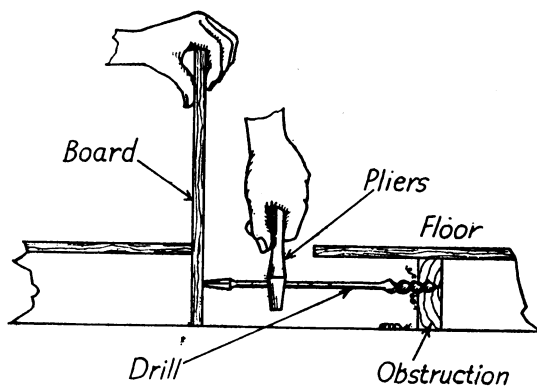


Fig. 384

Questions:

1. *What is the difference between a plate and a bridge?*
2. *Will the removal of a bridge weaken a partition dangerously?*
3. *Will the cutting of a plate weaken the building?*

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Carrying conductors around a bridge

References:

Croft, "Wiring of Finished Buildings," p. 202.

Nelson, "Interior Electric Wiring and Estimating," p. 81.

Directions:

1. In plaster. Locate position of bridge behind plastered wall, either by sounding with a "mouse," by sounding the partition with a hammer, or by any other process that will locate the bridge.

Lay back wall paper, if present, according to customary method, leaving a bare spot on plaster at the bridge. Cut into the plaster with a chisel, making a vertical groove extending to both sides of the bridge.

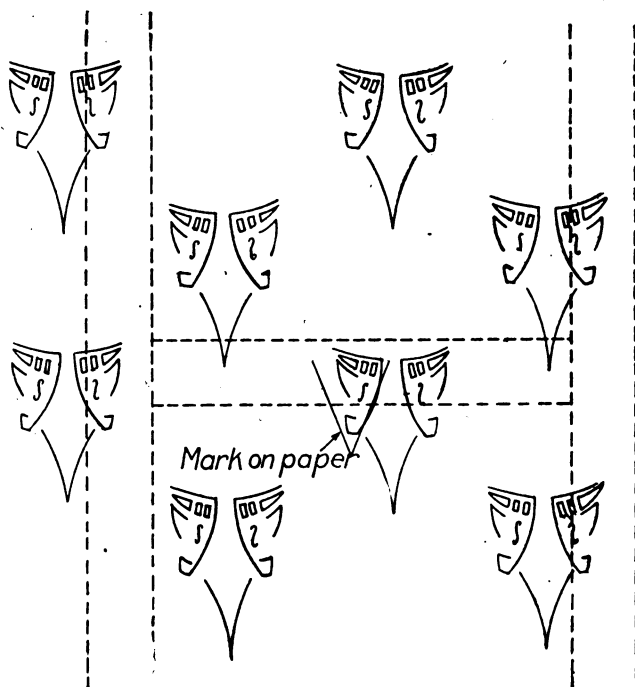
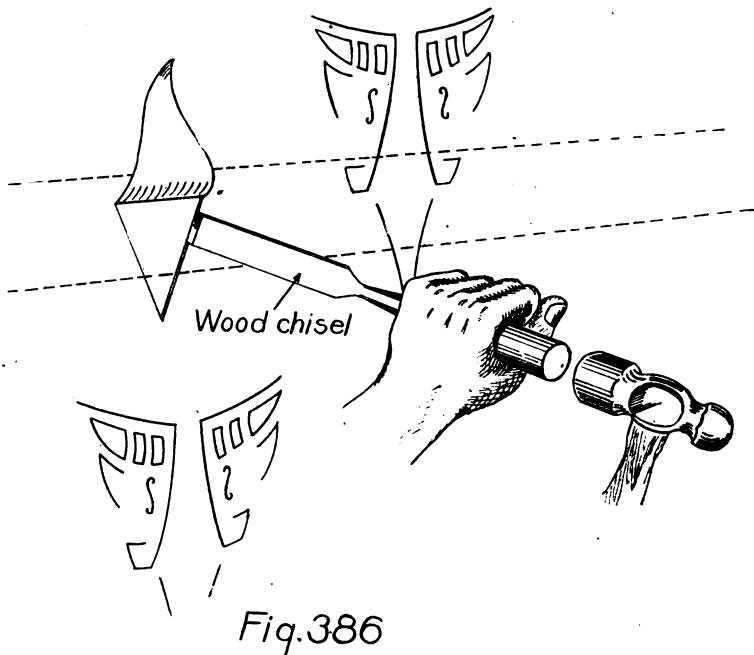


Fig. 385

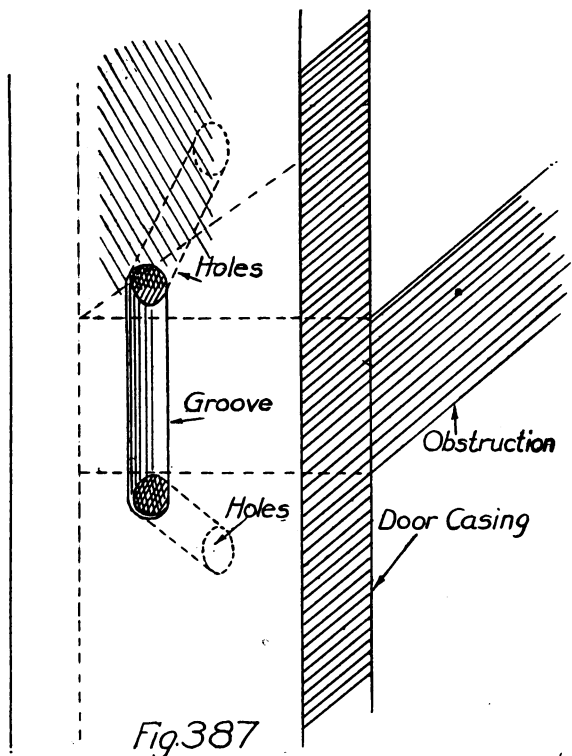
2. Drill through or remove lath at the groove. Fish flexible conductor or conduit through groove on one side of bridge, pass flexible conductor around bridge and fish through partition on opposite side of bridge. If necessary, cut a notch in bridge so conductor or conduit will lay below plaster.

Fill opening with plaster of Paris and replace wall paper.



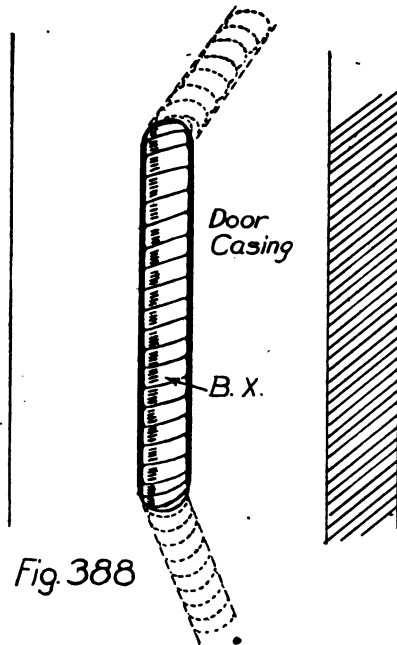
3. In door jamb. Remove door stop carefully, and drill two holes through door jamb, one on each side of bridge and slanting in opposite directions.

Cut a connecting groove in jamb between holes drilled.



4. Fish flexible conductor or conduit through one hole, pass around bridge in groove, and fish back into partition through hole in opposite end of groove.

Replace door stop over groove and conceal groove, taking care not to drive nails into groove.



Questions:

1. Is it possible to knock out bridges from openings in basement or from floor above?
2. How many runs of a flexible conduit or flexible armored conductor can be fished around a bridge under a door stop?

ELECTRICAL DEPARTMENT INTERIOR WIRING

Tracing and testing circuits

References:

Croft, "American Electrician's Handbook," p. 54.

Sengstock, "Electrician's Wiring Manual," p. 47.

Directions:

1. By pulling. When conductors are sufficiently loose in raceways to permit of movement, select one conductor at one end of raceway and pull slowly, as if removing it from raceway. Have the helper observe at other end of raceway which conductor moved. Have him check the conductor by pulling it back into raceway. Check each conductor in the same manner.

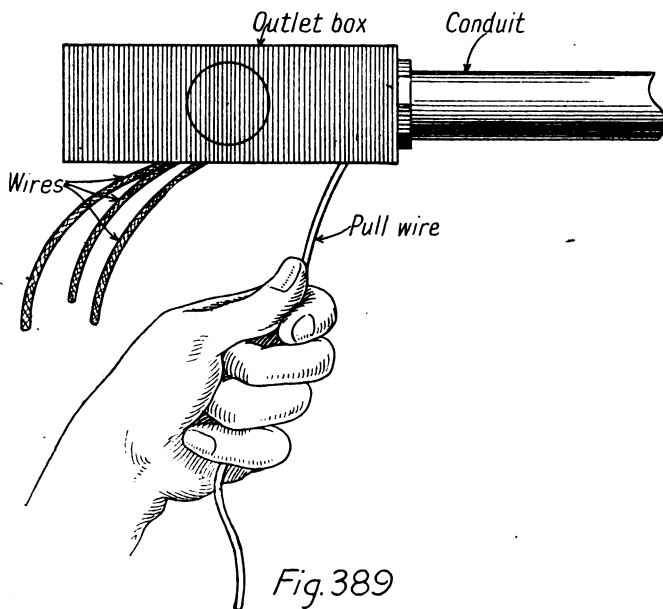


Fig. 389

2. By color code or markers. When conductors are marked with insulation or braids of various colors, trace conductors by observing such markings. Flexible armored conductors are usually marked for ready distinction.

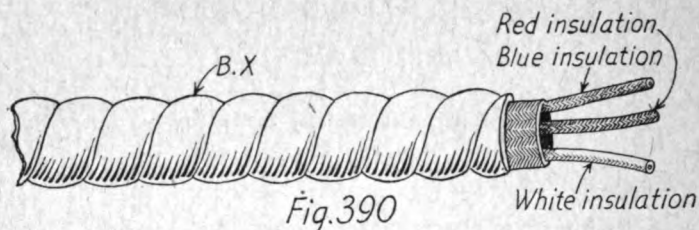


Fig.390

3. By ground test. When conductors are run in metallic raceways or when a grounded circuit such as gas or water piping is available, attach one side of battery or magneto circuit to ground or metallic raceway at one end of run and the other side of battery or magneto to one conductor. At other end of circuit, separate conductors, and touch one conductor at a time to raceway or ground circuit. The selection of proper conductor is indicated by ringing of bell in battery or magneto circuit.

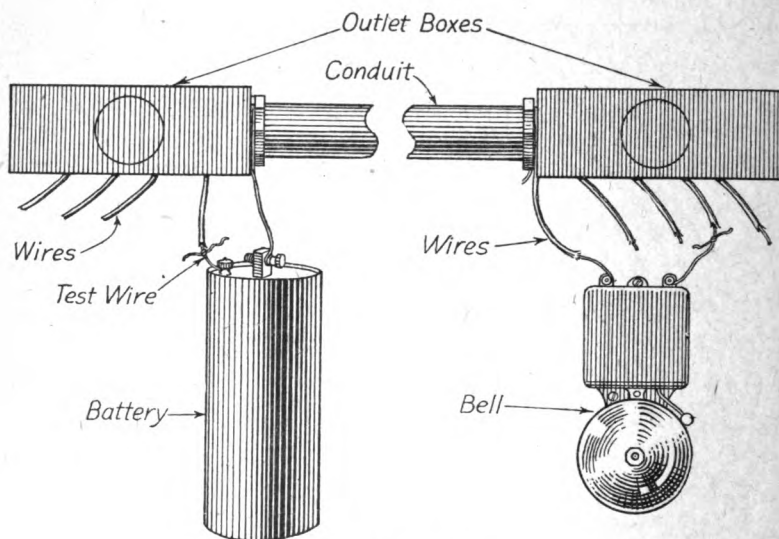


Fig.391

4. By metallic test. When no ground circuit is available connect battery or magneto to any pair of conductors at one end, and find corresponding pair at opposite end by touching

con
end, a

conductors in pairs until proper pair is found. Then twist both ends of this pair together and use as one conductor. Proceed with other conductors as in the Ground Test, using the twisted pair in place of the ground circuit.

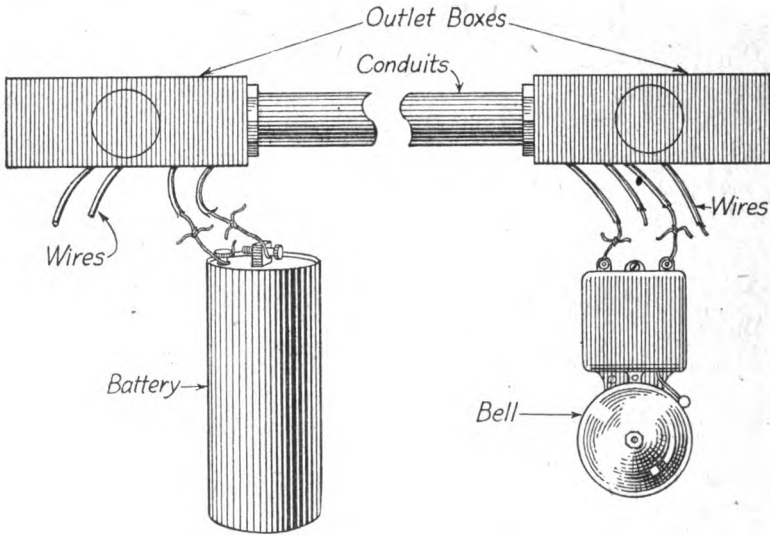


Fig. 392

Questions:

1. Why is it necessary to pull slowly in the Pull Test?
2. Can main line current be used in testing instead of battery or magneto?
3. What special precaution is necessary when using main line current?
4. How are conductors tested for short circuits, open circuits, or "grounds"?

ELECTRICAL DEPARTMENT
INTERIOR WIRING

Grounding conduit or molding

References:

Croft, "American Electrician's Handbook, p. 469 and p. 509.

Croft, "Wiring for Light and Power," p. 309.

Nelson, "Interior Electric Wiring and Estimating," p. 85.

Sharp, "Practical Electric Wiring," p. 119.

Directions:

1. Using a locknut. Unscrew a locknut from the outside of a standard box, located as near as possible to the ground connection to which the conduit will be grounded. Remove enamel from the side of the box, under the locknut, and any rust or enamel from the conduit or threads between the locknut and the box.

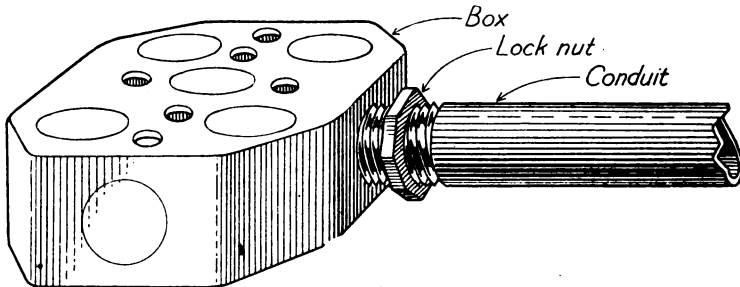


Fig. 393

2. Pass the ground wire, using nothing smaller than a No. 10 copper wire, around the threads of the conduit, between the locknut and the box. Make the loop in the correct direction, so that in tightening the locknut it will tend to close up the loop in the ground wire. Screw up the locknut firmly against the box, and test for looseness of the ground wire.

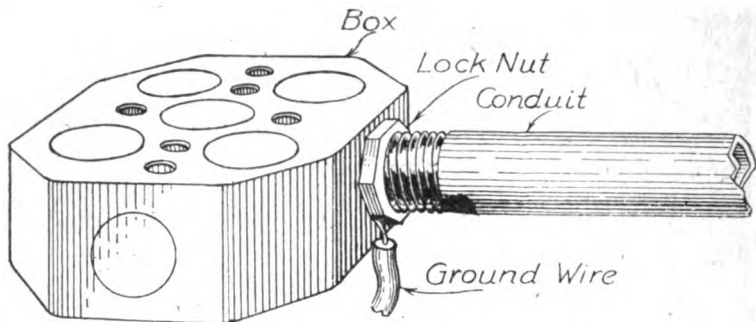


Fig. 394

3. Using a ground clamp. Clean the surface of the conduit or molding to which the ground clamp will be attached. Wrap the ground clamp strap around the clean surface and hook or bolt the strap into a closed loop.

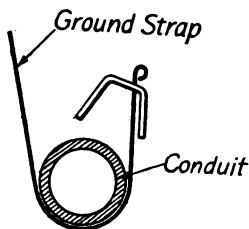


Fig. 395

4. Bring the closed loop of the ground clamp into firm contact with the conduit or molding by tightening the set-screw or bolt used for the purpose.

Attach the ground wire, using a wire no smaller than a No. 10 copper wire, either by soldering it to the clamp or by attaching it under a connecting screw.

Connect opposite end of ground wire to water, gas, or other pipe, on street side of meter.

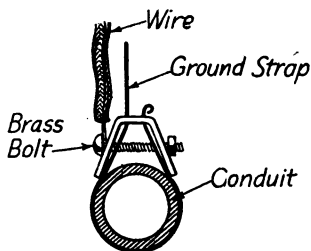


Fig. 396

Questions:

1. *Why is it advisable to bring the ground connection on the street side of the meter of the pipe system to which the conduit is grounded?*
2. *Why is it necessary to use a large ground wire?*
3. *How is the ground wire installed and protected?*

ELECTRICAL DEPARTMENT INTERIOR WIRING

Installing bell and signal wiring

References:

Croft, "American Electrician's Handbook," p. 527.

Sharp, "Practical Electric Wiring," p. 32.

Directions:

1. On beams or joists. Install all conductors parallel with each other. If ordinary staples are used without insulation only one conductor must be placed under each staple, and staples must be staggered so they will not touch each other.

If insulated staples are used, two or more conductors may be placed under one staple, but care must be taken in driving the staple not to break the insulation and short-circuit the conductors.

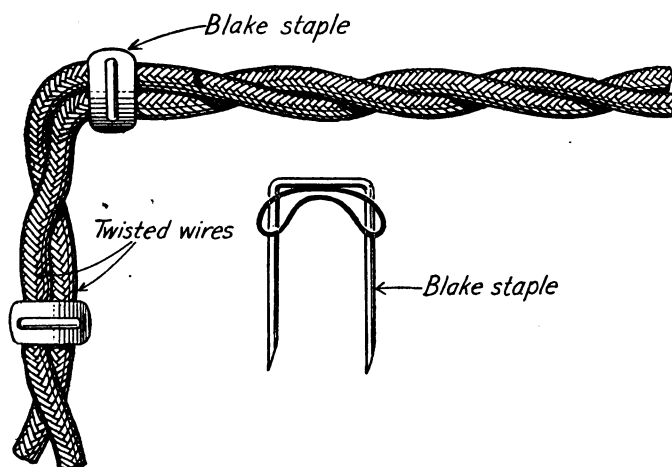


Fig. 397

2. On woodwork or molding. Install conductors as twisted wire, if twisted conductors are not available.

Lay the twisted conductors along the edge of woodwork, molding, or special furniture, holding them in place with insulated nails, driven between conductors into the woodwork. Be careful not to drive the nails through the conductors and break wires.

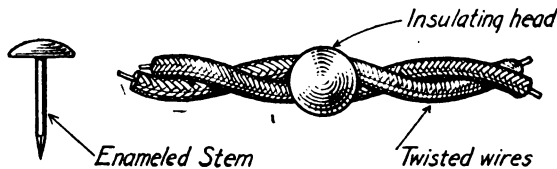
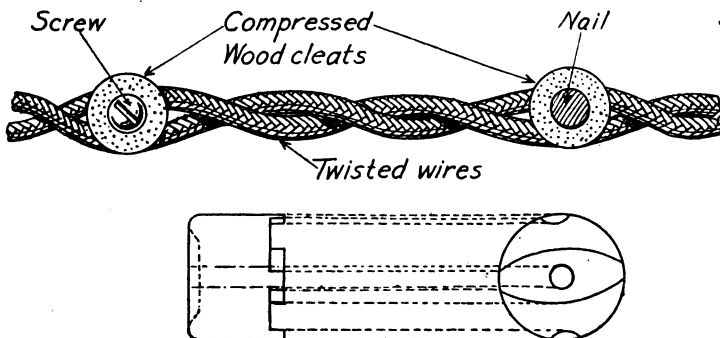


Fig. 398

3. On plaster. Install conductors over plastered surfaces by stringing the conductors along the surface and holding conductors in place with fiber or wooden cleats made for the purpose. Fasten the cleats to wall with screws of sufficient length to enter lath or studding.



4. Make good twisted splices at all joints, using either a rat-tail or a Western Union joint, and tape joints carefully. For neat work, ordinary tape, torn to half width permits of a better job of taping than tape of standard width. Soldering is not required.

Do not make turns or bends too sharply, as there is danger of breaking the conductor at a right angle bend.



Fig. 400

Questions:

1. *When is it advisable to install bell or signal wiring in conduit?*
2. *Why is rubber-covered wire not required for bell or signal wiring?*
3. *Is the Code for bell wiring modified if the bell-ringing current is taken from a small transformer instead of batteries?*

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